Economic impact of the Commission's 'opt-out' proposal on the use of approved GM crops

Quick assessment of the medium-term economic consequences

Robert Hoste, Coen van Wagenberg and Jo Wijnands

LEI WAGENINGEN UR

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The European Commission proposed the opportunity for individual EU Member States to restrict or prohibit the use of GMOs in food or feed on their territory (a national 'opt-out'). The economic impact on individual sectors of the feed and food chain (the vegetable oil and meal industry, trade, animal feed industry, livestock sector) of a possible opt-out policy for soy by individual Member States has been assessed by LEI Wageningen UR.
A single scenario was defined in which the four countries France, Germany, Poland and Hungary choose an 'opt-out' policy for soy. Consequences of this switch to non-GM soy and substitutes were assessed both quantitatively and qualitatively for feed prices, for production costs for animal production, for crushing industry and for trade, with a focus on the medium term.

Key words: European Commission, GMO, opt-out, soy, animal feed, France, Germany, Poland, Hungary

P.O. Box 29703, 2502 LS The Hague, The Netherlands, T +31 (0)70 335 83 30,
E informatie.lei@wur.nl, www.wageningenUR.nl/en/lei. LEI is part of Wageningen UR (University & Research centre).

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Preface

The European Commission proposed the opportunity for individual EU Member States to restrict or prohibit the use of GMOs in food or feed on their territory (a national ‘opt-out’). The EU animal feed industry is a main user of GMOs, such as GM soy or GM maize. The impact on individual sectors of the feed and food chain (the vegetable oil and meal industry, trade, animal feed industry, livestock sector) of a possible opt-out policy for some or all of these products by individual Member States has not been assessed by the EU Commission.

LEI Wageningen UR performed a quick assessment of the economic impact of this European Commission’s proposal. Economic consequences were estimated for the scenario in which the four countries France, Germany, Poland and Hungary choose an ‘opt-out’ policy for all GM ingredients for animal feed on their territories, with a particular focus on soy. Consequences of this switch to non-GM soy and substitutes were assessed both quantitatively and qualitatively for feed prices, for production costs for animal production, for crushing industry and for trade, with a focus on the medium term.

The assessment was based on public production and export databases, input of some interviewees and an analysis of the French organisation Cereopa on economic consequences of a ban on GM soy in France. The project was performed with funding from Coceral, Fediol and Fefac. It does not necessarily reflect their viewpoints.

Prof.dr.ir. Jack G.A.J. van der Vorst
General Director Social Sciences Group - Wageningen UR

Executive summary

S.1 Key findings

It will be a serious challenge to fulfil the protein demand for animal feed in the medium-term period (3-5 years) if Germany, France, Poland and Hungary choose to prohibit the use of genetically modified feed ingredients, in particular soy, a so-called opt-out policy. See Section 3.1.

To provide a sufficient quantity of non-GM soybeans for animal feed in these countries, about 70% of the expected worldwide availability of non-GM soybeans would be needed. To be able to fulfil the EU demand for non-GM soybean meal demand used in animal feed, a combination of measures is necessary, i.e. meal out of remaining beans, feed-saving measures and application of protein substitutes. This strategic decision would lead to a fierce tension on the world market for non-GM soybeans, and non-GM soybean meal. See Section 3.1.

No significant negative effects for the crushing industry in the four opt-out countries are expected, because neither the amounts of soybeans nor those of rape and sunflowers to be processed are expected to decrease. See Section 3.2.

Non-GM soy is expected to become more expensive. Feed prices are expected to increase by 0.3 to 9.3% by banning GM soy as feed component, depending on the animal category. Poultry feed will see the highest increase. The increasing feed prices will lead to additional production costs for industrially produced compound feed of about €390m to €845m per year in the opt-out countries, which equals about 2.5% of the total feed costs. France and Germany will experience the highest cost increase of about €140 to €300m each per year. These increased costs are expected to put pressure on the competitive position of the animal production sectors in these countries. However, the extent to which this might happen depends on the extent to which the additional costs can be transmitted to other stakeholders in the supply chain, including consumers. See Section 3.5.

S.2 Complementary findings

Total trade of animal feed ingredients in the EU is likely to be constant or might even increase. However, EU trade will shift from import through seaports in the west of the EU to sourcing in the EU or from neighbouring countries, related to increased production of non-GM soy and substitutes in south-east Europe, such as rapeseed, sunflower and other protein crops. This may hurt the transhipment sector in countries with seaports, such as the Netherlands and Belgium, and promote transport activities in the Eastern part of the EU. See Section 3.3.

Given the expected challenging non-GM protein balance in the opt-out situation, a quick transition would cause far heavier trade distortions than a long-term transition. A long-term transition is needed for supply chain partners in their process adaptation. Implementing hard identity-preserved systems (IP) for non-GM crops in producing countries, at farm level and in the supply chain logistics, demands both transition time and an investment. A sufficient non-GM premium is obviously needed for such a transition.

Support of the European protein crop production for animal feed, e.g. by subsidies, might be helpful to allow for a quick transition towards a higher self-sufficiency of non-GM soy and soy substitutes in the EU, and to alleviate the current non-GM soy scarcity. Expansion of the use of novel protein sources in animal feed such as insects and seaweed, or reallowance of processed animal proteins as an ingredient for animal feed could lower the dependency on imported soy for the animal feed sector in the EU as well but will require time and social acceptance. See Section 4.2.

S.3 Method

The European Commission has adopted and transmitted to the Parliament and Council a Proposal for a Regulation (COM/2015/0177 final – 2015/0093 (COD)) [1] regarding the possibility for individual EU Member States to restrict or prohibit the use of GMOs in food or feed on their territory (a national 'opt-out'). The EU animal feed industry is a main user of GMOs, such as GM soy or GM maize. The impact on individual sectors of the feed and food chain (the vegetable oil and meal industry, trade, animal feed industry, livestock sector) of a possible opt-out policy for some or all of these products by individual Member States has not been assessed by the EU Commission. LEI Wageningen UR performed a quick assessment of the economic impact of this European Commission's proposal, as far as related to soy.

In a quick assessment, economic consequences were estimated for the scenario in which the four countries France, Germany, Poland and Hungary choose an 'opt-out' policy for all GM ingredients for animal feed on their territories, with a particular focus on soy. These countries represent about 30% of the European soy demand. These countries are referred to as 'opt-out countries' for readability, although they are merely seen as potential opt-out countries. Other EU Member States are assumed to allow use of GM crops.

Based on public production and export data bases, information was collected on availability of non-GM soybeans, soybean meal and substitutes. Availability of non-GM crops on the world market was approximated per product by the sum of the export of countries with a net export of these products. Based on these data, a balance of EU demand and world availability was constructed. Using estimates for reduction and substitution of soy in animal feed, it was assessed whether the world supply could provide sufficient non-GM protein for animal feed in the four opt-out countries and the rest of the EU.

The economic consequences of this switch to non-GM soy and substitutes were assessed both quantitatively and qualitatively for feed prices, for production costs for animal production, for crushing industry and for trade, with a focus on the medium term. An analysis of the French organisation Cereopa on the economic consequences of a ban on GM soy in France was used to assess effects for feed composition and price, as a case study. Additionally, some telephone interviews were held with stakeholders throughout the supply chain. See Section 1.3.

[1] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52015PC0177

Samenvatting

S.1 Belangrijkste uitkomsten

Het wordt een grote uitdaging om op de middellange termijn (drie tot vijf jaar) te voldoen aan de vraag naar eiwitten voor diervoeder als Duitsland, Frankrijk, Polen en Hongarije ervoor kiezen om het gebruik van genetisch gemodificeerde diervoederingrediënten, en in het bijzonder soja, te verbieden (een zogenaamd 'opt-out'). Zie hoofdstuk 3.1.

Om voldoende niet-genetisch gemodificeerde sojabonen voor diervoeder aan deze landen te kunnen leveren, zou ongeveer 70% van de verwachte wereldwijde beschikbaarheid van niet-genetisch gemodificeerde sojabonen nodig zijn. Om aan de vraag vanuit de EU naar het in diervoeder gebruikte meel van niet-genetisch gemodificeerde sojabonen te kunnen voldoen, moeten er verschillende maatregelen worden getroffen: meel maken van de resterende bonen, diervoederbesparende maatregelen nemen en eiwitvervangers gebruiken. Deze strategische beslissing zou leiden tot een sterke spanning in de wereldmarkt voor (meel op basis van) niet-genetisch gemodificeerde sojabonen. Zie hoofdstuk 3.1.

Er worden geen significante negatieve effecten verwacht voor de oliefabrikanten in de vier landen die voor een opt-out hebben gekozen, omdat de hoeveelheid te verwerken sojabonen, koolzaad en zonnebloemen naar verwachting niet zal dalen. Zie hoofdstuk 3.2.

Verwacht wordt dat niet-genetisch gemodificeerde soja duurder zal worden. De prijzen van diervoeder zullen, afhankelijk van de diercategorie, naar verwachting met 0,3 tot 9,3% stijgen als er geen genetisch gemodificeerde soja meer wordt gebruikt in diervoeder. De prijzen van pluimveevoeder zullen het sterkst stijgen. De stijgende prijzen zullen leiden tot extra productiekosten voor industrieel geproduceerde mengvoeders ter hoogte van ca. € 390 miljoen tot € 845 miljoen per jaar in de landen die voor een opt-out kiezen. Dat is ongeveer 2,5% van de totale kosten voor diervoeder. De kostenstijging is het grootst in Frankrijk en Duitsland: ongeveer € 140 miljoen tot € 300 miljoen per jaar per land. Deze hogere kosten zullen de concurrentiepositie van de sector dierlijke productie in deze landen waarschijnlijk onder druk zetten. In hoeverre dit zal gebeuren, hangt ervan af in hoeverre de extra kosten kunnen worden doorberekend aan andere stakeholders in de toeleveringsketen, waaronder de consument. Zie hoofdstuk 3.5.

S.2 Overige uitkomsten

De totale handel van diervoederingrediënten in de EU zal waarschijnlijk constant blijven of misschien zelfs toenemen. Er vindt echter een verschuiving plaats van invoer via zeehavens in het westen van de EU naar sourcing in de EU of aangrenzende landen, die kan worden gerelateerd aan de toegenomen productie van niet-genetisch gemodificeerde soja en vervangende producten, zoals raapzaad, zonnebloemen en andere eiwithoudende gewassen, in Zuidoost-Europa. Dit kan nadelige gevolgen hebben voor de overslagsector in landen met zeehavens, zoals Nederland en België, en de transportactiviteiten in het oosten van de EU bevorderen. Zie hoofdstuk 3.3.

Gezien de verwachte uitdagingen omtrent de beschikbaarheid van niet-genetisch gemodificeerde eiwitten als de vier landen inderdaad kiezen voor een opt-out, zou een snelle overgang voor veel grotere handelsverstoringen zorgen dan een geleidelijke overgang, verspreid over een langere periode. Een geleidelijke overgang is nodig zodat partners in de toeleveringsketen hun processen kunnen aanpassen. Het implementeren van hard IP-systemen (Identity Preserved) voor niet-genetisch gemodificeerde gewassen in de producerende landen, zowel op bedrijfsniveau als in de toeleveringsketen, vereist niet alleen een lange overgangsperiode, maar ook een investering. Om een dergelijke overgang te kunnen realiseren, moet er een goede premie zijn voor niet-genetisch gemodificeerde gewassen.

Steun voor de Europese productie van eiwithoudende gewassen voor diervoeder, bijv. via subsidies, kan nuttig zijn om een snelle overgang naar een grotere zelfvoorzieningsgraad met betrekking tot niet-genetisch gemodificeerde soja en sojavervangers in de EU mogelijk te maken en om de huidige schaarste aan niet-genetisch gemodificeerde soja te verminderen. De afhankelijkheid van ingevoerde soja voor de diervoedersector in de EU zou kunnen worden verminderd door meer gebruik te maken van nieuwe eiwitbronnen in diervoeder, zoals insecten en zeewier, of het gebruik van verwerkte dierlijke eiwitten als ingrediënt voor diervoeder opnieuw toe te staan, maar dat proces behoeft tijd en sociale acceptatie. Zie hoofdstuk 4.2.

S.3 Methode

De Europese Commissie heeft een voorstel voor een Verordening (COM/2015/0177 final – 2015/0093 (COD)) [2] aangenomen en toegezonden aan de het Parlement en de Raad wat betreft de mogelijkheid voor afzonderlijke EU-lidstaten het gebruik van ggo's in levensmiddelen en diervoeders op hun grondgebied te beperken of te verbieden (een nationale 'opt-out'). De Europese diervoederindustrie is een grootgebruiker van ggo's zoals genetisch gemodificeerde soja of mais. De Europese Commissie heeft geen studie gedaan naar de impact op afzonderlijke sectoren in de toeleveringsketen voor levensmiddelen en diervoeder (de plantaardige-olie-industrie, de meelindustrie, de handel, de diervoederindustrie en de veesector) als bepaalde lidstaten kiezen voor een opt-out voor sommige of al deze producten. LEI Wageningen UR heeft een snelle beoordeling uitgevoerd van de economische impact van dit voorstel van de Europese Commissie voor zover het betrekking heeft op soja.

In een snelle beoordeling is een schatting gemaakt van de economische gevolgen voor het scenario dat de vier landen – Frankrijk, Duitsland, Polen en Hongarije – kiezen voor een 'opt-out' voor alle genetisch gemodificeerde ingrediënten voor diervoeder op hun grondgebied, waarbij in het bijzonder is gekeken naar soja. Deze landen vertegenwoordigen zo'n 30% van de Europese vraag naar soja. De vier genoemde landen worden in dit document voor de leesbaarheid de 'opt-out landen' genoemd, hoewel ze in de basis worden beschouwd als potentiële opt-out landen. Aangenomen wordt dat andere EU-lidstaten het gebruik van genetisch gemodificeerde gewassen wel toestaan.

Op basis van openbare databanken op het gebied van productie en uitvoer is informatie verzameld over de beschikbaarheid van (meel op basis van) niet-genetisch gemodificeerde sojabonen en vervangende producten. De beschikbaarheid van niet-genetisch gemodificeerde gewassen in de wereldmarkt is benaderd door per product de som te nemen van de uitvoer van landen met een netto-uitvoer van deze producten. Aan de hand van deze gegevens is een balans opgesteld van de vraag vanuit de EU en de beschikbaarheid wereldwijd. Op basis van schattingen van hoeveel minder soja er in diervoeder zal worden gebruikt, is beoordeeld of de wereldwijde toeleveringsketen voldoende niet-genetisch gemodificeerde eiwitten kon aanleveren voor diervoeder in de vier opt-out landen en de rest van de EU.

De economische gevolgen van deze overgang naar niet-genetisch gemodificeerde soja en vervangende ingrediënten werden zowel kwantitatief als kwalitatief beoordeeld op voederprijzen en op productiekosten voor de dierproductie, voor de oliefabrikanten en voor de handel, met een focus op de middellange termijn. Er is als casestudy gebruikgemaakt van een analyse van de Franse organisatie Cereopa van de economische gevolgen van een ban op genetisch gemodificeerde soja in Frankrijk om de effecten voor de samenstelling en prijs van diervoeder te beoordelen. Daarnaast zijn er telefonische interviews gehouden met stakeholders in de hele toeleveringsketen. Zie hoofdstuk 1.3.

[2] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52015PC0177

Abbreviations

Cereopa	Centre d’Etude et de Recherche sur l’Economie et l’Organisation des Productions Animales (Centre for study and research on economy and organisation of animal production)
COCERAL	Comité du Commerce des céréales, aliments du bétail, oléagineux, huile d’olive, huiles et graisses et agrofournitures (Trade commission of cereals, animal feed, oil seeds, olive oil, oils and fats and agro supply)
EC	European Commission
EU	European Union
FEDIOL	Federation representing the European Vegetable Oil and Protein meal Industry in Europe
FEFAC	European Feed Manufacturers’ Federation
GM	Genetically modified
GMOs	Genetically modified organisms
IP	Identity preserved
k	thousand
LEI	LEI Wageningen UR
LLP	Low level presence
LP	Linear programming
m	million
SFR	Schothorst Feed Research
UK	United Kingdom

1 Introduction

1.1 Background

The European Commission has regulated cultivation, food and feed use and import of genetically modified organisms (GMOs) (Directive 2001/18/EC and Regulation (EC) No 1829/2003), whether processed or unprocessed. Prior to its cultivation, use or import, a GMO has to be appropriately authorised in the European Union (EU). Authorisation can be limited to use and import into the EU, or may also include cultivation. The extent of the authorisation depends on the scope chosen by the applicant and on the decision of the EU authorities. Up to now, authorisation is valid in all European Union (EU) Member States.

The EU enforces a zero tolerance policy on unauthorised GMOs, with a 0.1% tolerance Low Level Presence (LLP) threshold for testing, which applies only to feed. This means that imports of authorised GM commodities or of non-GM commodities containing more than the tolerance LLP threshold of unauthorised GMOs will be rejected. Both asynchronous approval and asymmetric approval can result in traces of unauthorised GMOs in agricultural commodities imported in the EU (Stein and Rodríguez-Cerezo, 2010). With asynchronous approval, new GM crops received approval in a third country prior to approval in the EU, and with asymmetric approval, the developer of the new GM crop did not seek approval in the EU.

Labelling of GM food and feed products is laid down in Regulation (EC) No 1829/2003 and Regulation (EC) No 1830/2003. Food and feed produced from GMOs must be labelled as GM, or as produced from GMOs. Food and feed products containing more than 0.9% GM material have to be labelled as GM. Products containing less than 0.9% GM material, resulting from adventitious and technically unavoidable presence, do not have to be labelled. Food and feed produced with GMOs, such as meat, egg and milk from animals fed with GMOs or products produced with GM enzymes used as processing aids, do not have to be labelled.

Segregation between non-GM and GM product flows in countries producing both is achievable (Nowicki *et al.*, 2010). Segregation results in additional costs, which can vary significantly from one part of the supply chain to the other, across commodities, with the physical configuration of the supply chain, across regions, and over time (Nowicki *et al.*, 2010) and depending on the target (maximum 0.9% of EU-authorised GM in non-GM, maximum 0.1% for non-EU authorised GM events in commodities destined to feed use (Regulation (EC) No 619/2011) or 0 for non-EU authorised GM events in commodities destined to food use. Tillie and Rodriguez-Cerrezo (2015) estimated the additional cost for Identity Preservation (IP) of non-GM soybean and soybean meal imported in the EU at €42.4 and €81.1 per tonne of product, respectively.

In March 2015, the European Parliament and European Council amended the legislation to allow Member States to implement policies to restrict or prohibit the cultivation of a given GMO on all or part of their territory (Directive (EU) 2015/412). Such policies should be in conformity with European Union law, reasoned, proportional and non-discriminatory and be based on compelling grounds such as those related to environmental policy objectives, town and country planning, land use, socioeconomic impacts, avoidance of GMO presence in other products, agricultural policy objectives, or public policy. There is no possibility left to individual Member States to restrict or prohibit imports, feed or food use on their territory of GMOs authorised for these purpose at EU level. However, in April 2015 the European Commission adopted and transmitted to the European Parliament and Council a Proposal for a Regulation (COM/2015/0177 final - 2015/0093 (COD)) [3] regarding the possibility for individual EU

[3] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52015PC0177

Member States to restrict or prohibit the use of GMOs in food or feed on their territory (a national 'opt-out'), on similar grounds as for cultivation. However, such restriction/prohibition does not apply to consignments of food or feed containing less than 0.9% of EU-Approved GMOs (i.e. the labelling threshold). The EU animal feed industry is a main user of GMOs, such as GM soy, GM corn and corn by-products and GM rapeseed. The vegetable oil industry also processes GM oil seeds, resulting in both edible oil and meal; meal is being used in the feed industry. The impact on the different industries in the animal production supply chain of a possible opt-out policy for some or all authorised GMOs by individual Member States has not been assessed by the European Commission.

1.2 Goal

LEI Wageningen UR performed a quick assessment of the economic impact of this European Commission's proposal for a Regulation, Regulation (COM/2015/0177 final - 2015/0093 (COD), along the animal production supply chain, in particular on the crushing, feed and animal production sectors and as far as related to soy, to get insight into economic consequences for individual sectors of the feed and food chain (the vegetable oil and meal industry, trade, animal feed industry, livestock sector) in four EU Member States, i.e. France, Germany, Poland and Hungary.

1.3 Method and assumptions

The economic consequences are analysed for a scenario in which four countries, France, Germany, Poland and Hungary, choose an 'opt-out' policy for GM ingredients for animal feed on their entire territories. These countries represent about 40% of the EU soybeans and 60% of the soymeal import. Other EU Member States are assumed to allow use of GM crops. However, the present voluntary demand for non-GM crops in the other Member States is assumed to remain stable. The analyses are based on trade flows, implicitly assuming that domestic demand for food, feed, seeds and other uses do not change.

The analysis focuses on consequences in the medium term (3 to 5 years). It is assumed that a decision to apply an opt-out policy by Member States will not be taken from one day to another or immediately after a Commission's decision. The decision and implementation process is assumed to cover a sufficient period for traders, producers and processors to be able to adapt to changing market situations. The effects of an opt-out for soy in animal feed, in the crushing industry and in the animal production are assessed.

Theoretically it might be possible that Member States show different adoption strategies in terms of their choice of GM varieties to be accepted, restricted or prohibited. However, it is assumed that each of these four countries follow the same strategy and choose for a total 'opt-out' (food and feed use of all GM varieties will be prohibited).

In the analysis it is further assumed that the GM soy will be replaced by the non-GM protein substitutes: non-GM soy, non-GM rapeseed and sunflower. For assessing the cost effect only these products were analysed in this quick assessment, as they are the major alternative protein sources. In the analysis of meal availability we also take seeds and beans into account, since crushed seeds and beans provide meal to the feed industry in addition to oil for the food industry.

An opt-out policy in the four countries is regarded as a total ban on the use in GM products within the country, as far as use is intended on the territory of the country. However, it is assumed that supply chain participants in opt-out countries will be allowed to import live animals and animal products from opt-in countries, even if these animals were fed with GM feed ingredients.

In Section 2, the availability of non-GM soybeans, soybean meal and substitutes, is assessed, based on production and trade data. To perform this quick assessment an arithmetic model has been made to calculate current and expected product flows of GM and non GM-soy and substitutes. To this end information was retrieved on production, use, processing and trade in these products; this was done by desk research, retrieving papers and consulting existing easily accessible databases, with a strong preference for databases covering all countries in the world.

Production data are taken from FAOstat. The assessment of export and import is derived from UN Comtrade. We used the following balance equation for beans: Import + Domestic production = Export + Crushing + Other uses. Other uses refer to food, feed, sowing seeds, losses, etc. For meals we have a similar approach: Import + Domestic production from crushing beans = Export + Use as feed + Other uses. Other uses refer to food, losses, etc. The amount of soybeans available for crushing is the sum of net-import and domestic production. Insufficient availability of soybeans will have direct consequences on the crushing volume and on the domestic produced meals. Net-import is calculated as import minus export both for beans and meal.

We are looking only at net-trade flows, recognising domestic use of products. The domestic use includes the use for seed, food, feed, other purpose, and waste and losses. In fact we assume that no changes in the domestic use of beans/seeds or meal will occur except for the four opt-out countries or otherwise explicitly stated. In case of an increased demand for non-GM products in the opt-out countries, probably accompanied with a price increase, the current non-GM use in non-opt-out countries might change to GM product to some extent.

As no statistics on trade flows of non-GM products are available, the availability of non-GM beans/seeds and meal have been estimated. The trade in non-GM beans/seeds is estimated by the assumption that the export of each country is proportionally distributed according to the share of bean/seed production. For example: the soy area in the USA consists for 94% of GM soybeans and 6% non-GM soybeans, so for this analysis it was assumed that 6% of the soybean production, of the export of either soybeans or soybean meal export consists of non-GM soybeans. The share of non-GM crop production was based on GMO Compass for the production year 2013/14 and on personal communication of Coceral for 2014/15. The lowest non-GM share per country was used in the calculation to prevent overestimation. Implicitly we assume that the domestic demand for GM and non-GM soybeans is equally distributed with the production shares of GM and non-GM products. This approach seems insufficient for Hungary, as it produces only non-GM soy, but according to industry sources imports GM soy. However, as Hungary is one of the opt-out countries, it is not taken into account as an additional potential source of non-GM soy.

Total availability of non-GM beans/seeds on the world market is approximated by the sum of the export of countries with a net-export of beans/seeds. The export of non-GM beans/seeds by net-importing countries is assumed not to be available on the world market. For example, the Netherlands exports 1.3m tonnes of soybeans (the 8th largest exporter), whereas it hardly produces any soybeans. The export of the Netherlands is not included in the availability on the world market.

For the export of non-GM meal, a stronger assumption was made: the countries should be net-exporter of both meal and of beans/seeds of the particular commodity (soy etc.). The reason for this is that some countries are large importers of beans/seeds and exporters of meal (e.g. China). Then, the export of meal might be based on imported GM beans/seeds and is therefore not taken into account in the available amount of non-GM meal. This approach provides a conservative approximation (=low) of the availability of non-GM products.

Soybeans are sometimes recalculated to soybean meal equivalents by multiplying with the factor 0.785 (Hoste, 2014). Recalculation of rapeseed to rapeseed meal and sunflower seed to sunflower meal is based on the factor 0.55. For the purpose of this assessment the human soybean oil consumption for food is not considered in this study, as it could easily be replaced by other (non-GM) oils such as sunflower and/or rapeseed oil without any substantial quality or price differences. The latest available trade data have been used, usually 2014 or 2013. The method section elaborates the approach of assessing the availability of non-GM products.

A price premium for non-GM soybean meal has been assumed of €75 to €150, which is clearly higher than the current premium of about €30 to €60 per tonne. This price premium increase reflects the limited availability on non-GM soybean meal. Generally spoken, trade patterns will adapt swiftly to changing market demands. Especially with these high premiums for non-GM IP soybeans and meal it is assumed that solutions will be found for current technical and traceability restrictions. It is also assumed that these high prices are an attractive incentive for soy producers to produce non-GM soy and to segregate GM and non-GM soy flows.

In Section 3 the supply and demand of soybeans, soybean meal and substitutes in the four opt-out countries and the rest of the EU are shown and opportunities are assessed on whether or not it is possible to find a solution to provide sufficient non-GM protein for animal feed. Some additional assumptions for assessing this protein balance are given in Section 3.

In Section 3 the tension factor is the share of the quantity available non-GM product at the world market of the quantity that is needed to fulfil the requirements in the EU as a whole. If the tension factor amounts 100%, all the available product worldwide is needed to cover the demand. The factor reflects the pressure on the world market to get hold of sufficient volumes of the demanded product.

Based on telephone interviews with a number of stakeholders throughout the supply chain (see Appendix 1) and available expertise, consequences were assessed for feed prices, production costs for animal production, for crushing industry and for trade, both quantitatively and qualitatively.

The French organisation Cereopa made an analysis of consequences of a ban on GM soy for France (Le Cadre and Pressenda, 2015). The aim of the analysis was to complement our assessment with calculations on effects for feed composition and price, as a case study. Results have been used in the protein balance in Section 3. Additionally findings from Wagenberg and Hoste (2015) were used. In the assessment of changing feed compositions it was assumed that feed quality should not be changed and that adaptations (either reduction or substitution of soy) do not lead to losses in animal performance.

2 Current situation

This Section describes the current production and trade flow of soy and protein substitutes, as well provides some trends based on the past developments. These trends do not forecast possible developments. They just emphasise the past developments, such as on the one hand an increasing net import of soybeans and on the other hand a decreasing net import by the four opt-out countries.

2.1 Soy balance of the opt-out countries

This Section shows the current net-import of soybeans and soybean meal in the 4 countries. The net-import of these 4 countries amounts to 4.4m tonnes soybeans (Table A2.1) and 6.4m tonnes soybean meal (Table A2.2). In soybean meal equivalents, the net import amounts to 10.0m tonnes in 2014 in the 4 countries. This includes both GM and non-GM soy. The total net-import of soybeans in the rest of the EU amounts to 9.4m tonnes and of soybean meal to 10.6m tonnes in 2014. Looking at the development in imports in the last years, the-net import of soybeans in the four countries increased with 3.5% annually since 2009. Hungary switched in that period from being a net-exporter to a net-importer. The net-import of soybean meal in the four countries, 6.4m tonnes, decreased with 3.9% annually in the last 5 years. The trend from 2015 to 2020 onwards has been presented (Figure 2.1) based on the developments of the past period 2008-2014. These trends are just an illustration of the developments, if the past developments continue. The developments are also only used to evaluate the impact of assumptions made and do not intend to provide a forecast of the future development.

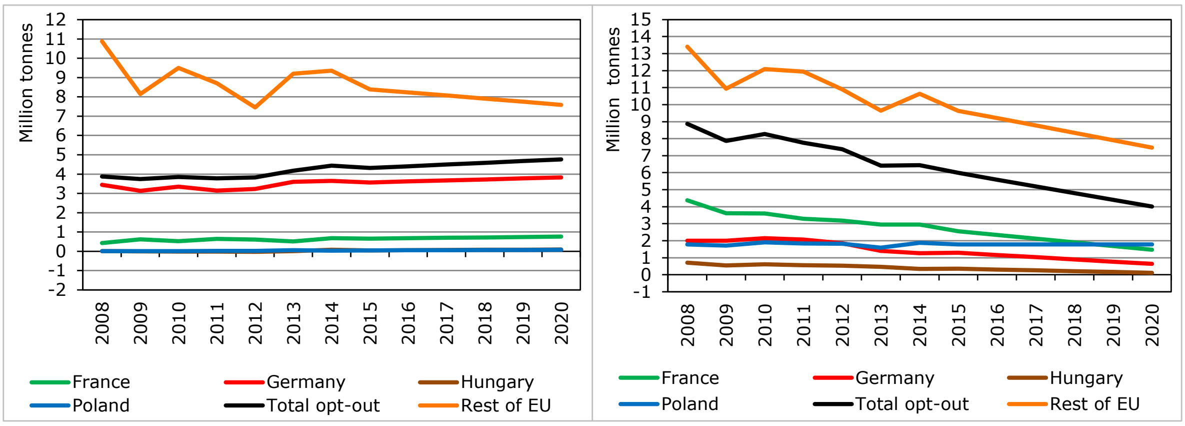

Figure 2.1 *Net import of soybeans and soybean meals into four opt-out countries and the rest of the EU*

Part of the current net imports already consists of non-GM soybean and soybean meal. Tillie and Rodríguez-Cerezo (2015) estimated the fraction of non-GM Identity Preserved (IP) soybean and soybean meal in the total extra-EU imports for each of the opt-out countries (Table 2.1). We assume that these shares apply to all trade flows (intra and extra EU trade) resulting in a net-import of GM soybean of 3.9m tonnes, or 2.9m tonnes of soybean meal equivalent, and of GM soybean meal of 5.5m tonnes in the four opt-out countries. In terms of soybean meal equivalent this is a total use of 8.4m tonnes of GM product per year. Current import of non-GM soybeans in the 4 countries and the rest of the EU is estimated at 515 and 401k tonnes, respectively (Table 2.1). For non-GM soybean meal these estimated imports amount to 898k tonnes into the 4 countries and 945k tonnes into the rest of the EU.

Table 2.1

Net import of total and of GM soybeans and soybean meal, and fraction of non-GM, per opt-out country and rest of the EU in 2014 (volumes in 1,000 tonnes; fraction in %)

Country	Soybeans				Soybean meal			
	Net import	Fraction Non-GM [1]	Non-GM net import	GM Net import	Net import	Fraction Non-GM [1]	Non-GM net import	GM Net import
France	673	10	67	606	2,950	10	295	2,655
Germany	3,650	10	365	3,285	1,271	20	254	1,017
Hungary	83	100	83	0	349 [3]	100	349	0
Poland	33	0	0	36	1,876	0	0	1,876
Total 4 opt-out	4,439		515	3,924	6,446		898	5,548
Rest of EU [2]	6,466		401	6,065	4,194		945	3,249

1 Source: Tillie and Rodríguez-Cerezo (2015).

2 Calculated as Total net import into the EU minus net import into the four opt-out countries.

3 COCERAL estimates Hungarian imports of soybean meal of 500-600 thousand tonnes per year, which they assume is 90% GM.

2.2 Production of (non-) GM soy and trade

This Section provides information on the production of soybeans and gives an estimate of the availability of non-GM soybeans. The area of GM soybeans is growing steadily from around 40% of the total world area of soybeans in 2000 to 79% in 2013 (GMO Compass, 2014) and an estimated 84% in 2014. Table 2.2 depicts the share of GM soybean in GM soy producing countries.

Table 2.2

Total production of soybeans (m tonnes in 2013), share of non-GM (%), calculated GM and non-GM soy production (million tonnes in 2013) and growth of total soy production (% per year in the years 2009-2014), per country and worldwide

	Share GM		Production			Growth of total production
Country	2013/14	2014/15	Total	GM	Non-Gm	
World	79	84	276.0	228.9	47.2	3.6
USA	93	94	89.5	84.1	5.4	2.1
Brazil	92	92	81.7	75.2	6.5	6.4
Argentina	100	95	49.3	49.3	0.0	1.3
China	0	0	12.0	0.0	12.0	-5.1
India	0	0	11.9	0.0	11.9	3.8
Paraguay	95	95	9.1	8.6	0.5	7.6
Canada	90	95	5.2	4.9	0.3	9.3
Uruguay	100	100	3.2	3.2	0.0	32.9
Ukraine	0	40	2.8	1.1	1.7	27.8
Bolivia	91	91	2.3	2.1	0.2	13.3
Ecuador	0	90	0.1	0.1	0.0	6.3
Colombia	0	90	0.1	0.1	0.0	8.7
Venezuela	93	94	0.0	0.0	0.0	-5.2
Guatemala	0	90	0.0	0.0	0.0	1.7
Peru	0	90	0.0	0.0	0.0	-4.3
France	0	0	0.1	0.0	0.1	11.8
Hungary	0	0	0.1	0.0	0.1	2.1
Germany	0	0	0.0	0.0	0.0	14.9
Poland	0	0	0.0	0.0	0.0	46.1
Rest of EU	0	0	1.0	0.0	1.0	10.5
Rest of world	0	0	7.5	0.0	7.5	6.4

Sources: GM Share 2013/14: GMO Compass; GM share 2014/15: personal communication with COCERAL, Ms. Elena Berloni; Production data based on FAOstat.

For the estimation of the non-GM soybean availability we used the latest (2014/15) GM area figures, except for Argentina, where we used the share of 2013 (100%). This means that we use always the highest share of GM-soybean production as to prevent overestimation of non-GM production. Worldwide around 47m tonnes of non-GM soybeans were produced in 2013. The countries with the largest production have the highest share in GM soybeans. China and India are non-GM producers with each a share of about 4.3% in the world production. The production in the EU of non-GM soybeans is a mere 1.2m tonnes, which is equivalent to 0.4% of the world production. Italy produces around half of this with 620k tonnes, France 110k tonnes, Hungary 82k tonnes and Germany and Poland up to 2k tonnes each. The total domestic soybean production in the four opt-out countries thus equals about 200k tonnes. Despite high growth rates of soy production in the EU, significant shares in the total world production are not expected in the near future.

Non-GM soybeans may:
- be segregated from GM soybeans in exporting countries and available for exports (processed or unprocessed)
- be used locally with or without segregation for use as sowing seeds, for human consumption or direct animal feeding (processed or unprocessed).

This means that not all non-GM soybeans are available for export for direct or indirect feed use.

Soybeans
The total world export of soybeans amounts to 120m tonnes in 2014 (Table 2.3). This is about 45% of world production, which is high relative to the trade share in most other agricultural products. No specific trade data on non-GM soybeans are publicly available. The trade in non-GM soybeans is estimated by the assumption that the export of each country is proportionally distributed according to the share of soybean production. The USA produced round 90m tonnes of soybeans of which about 5.4m tonnes are non-GM soybeans. By this approach 2.5m tonnes of non-GM soybeans are used domestically and 3m tonnes are exported. Implicitly we assume that the domestic demand for GM and non-GM soybeans is equally distributed with the production shares of GM and non-GM products.

Total net export of exporting countries on the world market of non-GM soybeans is estimated at 8.6m tonnes, almost twice the level of the net-import demand for GM soybean of 4.4m tonnes of the 4 opt-out countries (see Table 2.1). As is shown in Table 2.3 the EU is a net importer of 13.8m tonnes of soybeans. However based on the previous mentioned assumptions, 0.1m tonnes non-GM is available for net-export. The EU is the aggregate of all Member States: the non-GM export is not yet discounted by imports of other Member States. The approach is aiming at estimating the availability of non-GM soybeans. By this approach we show that on world level in total 8.6m tonnes might be available. In the 2014 that quantity is of course imported by other countries, as total import and total export are by definition equal. So at least theoretically, and irrespective of logistics, additional costs, quality requirements, or demands by other countries, the non-GM soybeans demand of the four opt-out countries could be satisfied by the current availability. Section 3.1 assesses the protein balance in more detail. The methodological considerations for the approach of net-export is further discussed below.

Table 2.3

Soybean trade per country, total export and estimated non-gm export (m tonnes in 2014) and annual growth in the years 2009-2014 (%) of largest exporting countries and rest of the world

Country	Export		Import		Available net export	
	Volume	Growth	Volume	Growth	Total Volume	Volume non-GM
Total	119.6	8.0	111.2	8.1		8.6
USA	50.2	4.4	2.0	36.9	48.2	3.0
Brazil	45.7	9.9	0.6	42.2	45.1	3.7
Argentina	7.4	11.6	0.0	-69.4	7.4	0.0
Paraguay	4.8	17.9	0.0	-19.5	4.8	0.2
Uruguay	3.5	26.5	0.0	-7.6	3.5	0.0
Canada	3.5	8.9	0.3	-3.8	3.2	0.2
Ukraine	1.7	44.8	0.0	35.0	1.7	1.0
Netherlands	1.3	6.2	3.6	12.0	-2.4	
China	0.2	-9.8	71.4	10.9	-71.2	
India	0.2	32.3	0.0		0.2	0.2
Bolivia	0.2	8.8	0.0	-14.4	0.2	0.0
Belgium	0.1	-3.7	0.3	-13.9	-0.2	
Rest of world	0.7	6.3	32.9	3.2	-32.1	0.3
Total EU	1.8	5.8	15.6	3.3	-13.8	0.1

Note: Part of the available export volumes of non-GM soybeans might not be useable (yet) for European demand of non-GM IP soybeans, as some countries cannot guarantee that the commingling with GM soy is below the EU threshold.

Source: Based on UN Comtrade.

Soybean meal

Total availability on the world market of non-GM soybean meal is estimated at 4.0m tonnes (Table 2.4). This reflects about 60% of the net import need for GM soybean meal of the 4 opt-out countries of 6.4m tonnes annually (Table 2.1).

Table 2.4

Soybean meal trade per country, total export and estimated available non-gm export (m tonnes in 2014) and annual growth in the years 2009-2014 (%) of largest exporting countries and rest of the world

Country	Export		Import		Available net export	
	Volume	Growth	Volume	Growth	Total Volume	Volume non-GM
Total	62.9	2.5	60.9	2.0		4.0
Argentina	24.7	2.7	0.0	-43.2	24.7	0.0
Brazil	13.7	2.3	0.0	-53.3	13.7	1.1
USA	7.8	0.3	0.3	38.8	7.5	0.5
Netherlands	3.9	2.0	4.3	6.2	-0.5	
Paraguay	2.3	17.8	0.0		2.3	0.1
India	2.1	-9.2	0.0	-16.2	2.1	2.1
China	2.1	13.2	0.0	-29.8	2.1	
Bolivia	1.5	10.4	0.0	0.0	1.5	0.1
Germany	1.4	1.5	2.7	-4.1	-1.3	
Rest of world	3.3	3.5	53.6	2.0	-50.3	0.0
Total EU	7.5	1.0	24.6	-1.1	-17.1	0.0

Note: Part of the available export volumes of non-GM soybean meal might not be useable for European demand of non-GM IP soybean meal, as some countries cannot guarantee that the commingling with GM soy is below the EU threshold.

Source: Based on UN Comtrade.

However, not all the available non-GM beans and meal volumes can be used by opt-out countries in the EU. Although US and Canada produce some non-GM soy volumes, this is partly segregated for human consumption and partly commingled with GM soy. Non-GM soybean cultivation currently poses a risk of commingling with GM soybeans. For this reason, non-GM soybeans for the food market are stored and transported in containers. India has sufficient crushing capacity for their domestic soybean production. India faces a shortfall in vegetable oil and surplus of protein meals. It is therefore very unlikely to expect India to export non-GM soybeans, but likely to export non-GM soybean meal. However, the meal quality is not as good as EU feed processors would expect and markets in the vicinity like Pakistan or China are competitors. The risk of GM contamination is currently very high in Paraguay due to inefficient segregation of GM and non-GM soy in the supply chain.

Methodological considerations

In the assessment of the impact of 4 opt-out countries the consumption of soybeans and preferences for domestic production are not explicitly discussed. In this Section the possible impact of soybean for food consumption and priority for domestic use of domestic production is assessed. This additional analysis is based on the 2011 data from FAOstat commodity balances which is the last available data for all countries. More recent years do not cover all countries. In Figure 2.2 the top 5 producing countries are presented. These are also the countries with the largest domestic supply. These 5 countries count for 90% of the world production and for 81% of the world domestic utilisations. Net trade and net stock differences (negligible amounts) explain the difference between production and domestic supply. The domestic supply is the amount available for the domestic market only, as trade is already balanced in net trade. In the FAO commodity balance the Supply is calculated as Production + Stock variation + Import – Export = Domestic supply. The Utilisation is calculated as Domestic supply = Feed + Seed + Waste + Processing + Food + other Uses.

The majority of the soybeans (86.5%) is processed into oil and soybean meal. Almost all soybean meal is used as feed. FAO indicates that no soybean meal is used for food purposes and that only a very small part (2%) is used for other purposes. Small shares in the total utilisation of soybeans worldwide are for feed (5.1%), food (3.9%), seeds (2.6%), waste (1.6%) and other uses (0.3%). The share for food use of soybeans varies between almost zero (USA, Argentina) and 10% in the rest of the world. The EU has a share of 0.7% and China 7.9%. Waste is also rather high in the Rest of the world (6.5%) and in India (4.5%); the EU is just below the world's total (1.5%).

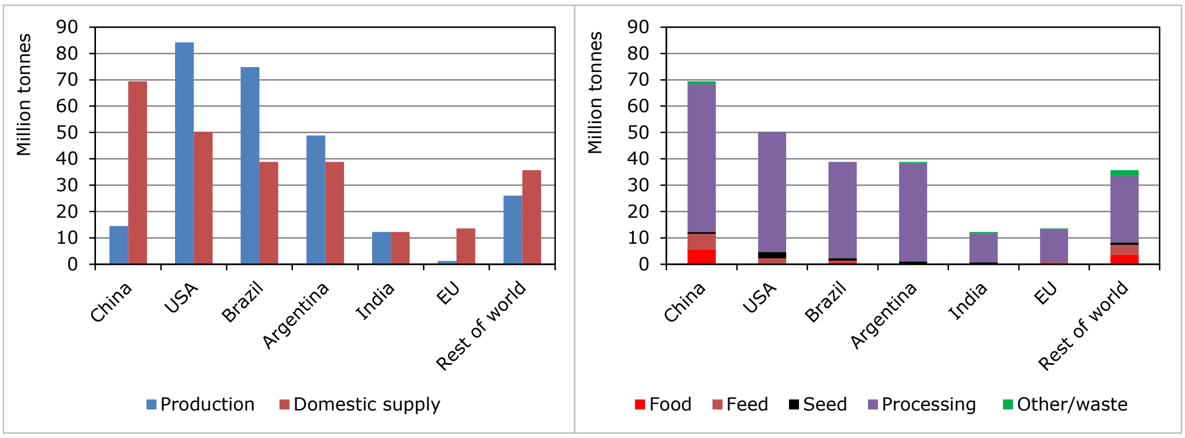

Figure 2.2 *Production and domestic supply (left figure) and utilisation of domestic supply of soybeans (million tonnes)*
Source: Calculation based on FAOstat commodity balances 2011.

To evaluate our assumption based on share of GM in production areas, we explored two other alternatives. These are:

1. The entire use of soybeans for food (3.9% of total production) should be non-GM. This implies that also a proportional share of seeds and waste should be of non-GM (0.2%). Round 11m tonnes of the soybeans are than needed for food purposes. This is less than 25% of the production of non-GM soybeans (Table 2.2. presents 47m tonnes production). This amount does not need to be subtracted from the availability estimated in Table 2.3, as that is the net-export available quantities: domestic utilisation is already taken into account. In fact round 36m tonnes of non GM are available for other destinations of which of course a significant share will be used domestically.
2. All domestic demand should be fulfilled as far as possible with own production. The remaining part is available for export. Only countries that are net-exporting, supplies to the non-GM soybeans. In all cases we assume that food is always non-GM. For the remaining part we assume that first GM will be used and if that is not sufficient, non-GM is used to meet the domestic utilisation. In this (theoretical) case the estimated quantity of non-GM available for other export is twice the level as if the afore mentioned production shares are used. The demand of soybeans for food by countries that have insufficient or no own production (including Argentina and Paraguay) is round 15% of the available amount non-GM soybeans. Applying these shares to volume available in 2014, the available amount of non GM can be estimated at least 50% higher. Note that Argentina –as one of the largest soybean producer with 100% GM soybeans, is in this alternative a net-importer of non-GM soy for food purpose.

Based on these two alternatives the used approach can be seen as a conservative estimate of the available volume of non-GM soybeans.

2.3 Alternatives for soybean meal in animal feed

2.3.1 Protein substitutes

Soybean meal is an important protein ingredient for animal feed, not only due to a high protein content but also the protein quality due to the high concentration of essential amino acids. Possible protein substitutes assessed here are rapeseed and sunflower. However, substitution of soy with rape or sunflower demands larger quantities, due to their lower content in protein and essential amino acids (Table 2.5). Based on protein content, 1.3-1.4 kg of rapeseed meal or sunflower meal is needed to substitute 1 kg soybean meal. Based on ileum digestible lysine, the necessary substitution even increases to 1.9 kg for rapeseed meal and 2.7 kg for sunflower meal.

Table 2.5
Contents of Crude protein and some essential amino acids (g/kg)

Product	Crude Protein	Lysine	Of which: Ileum digestible Lysine	Methionine + Cysteine	Of which: Ileum digestible methionine + cysteine
Soybean meal	464	28.8	25.5	13.5	11.5
Rapeseed meal	335	18.4	13.3	15.1	11.1
Sunflower meal	347	12.1	9.3	13.5	11.0

Soybean meal: crude protein < 480 g/kg, crude fibre < 45 g/kg; Rapeseed meal: crude protein < 380 g/kg; Sunflower meal: partly dehulled, crude fibre 160-200 g/kg.
Source: CBV, 2007.

The four opt-out countries produce a significant amount of barley, wheat and rapeseed: 10 to 20% of the world production (Table 2.6). The production of the other crops is rather small compared to the world production.

Table 2.6

Production (GM and non-GM) of soybeans, rapeseed and sunflower seed in the four opt-out countries, rest of the EU, EU as a whole and world total (m tonnes in 2013) and share of these countries and of the in the world total (%)

	Rapeseed	Sunflower seed	Soybeans
World	72.7	44.6	276.0
France	4.4	1.6	0.1
Germany	5.8	0.0	0.0
Hungary	0.5	1.5	0.1
Poland	2.7	0.0	
Total 4 countries	13.4	3.1	0.2
World share 4 opt-out (%)	18.4	7.0	0.1
Rest of EU	36.3	1.0	7.6
EU Total	49.7	4.1	7.8
Share EU in world (%)	68.3	9.3	2.8

Source: FAOStat.

Protein substitutes would come from own production and additional imports. As rape and sunflower are the substitutes with the highest protein content, current trade of rape and sunflower is analysed. Both products are available both as seeds and meals.

2.3.2 Trade in rapeseeds and meal

The four opt-out countries

The four opt-out countries together have a net import of 3.3m tonnes rapeseed (Table A2.3). Germany is the largest net-importer (Figure 2.3). Poland changed from a net-importer to a net-exporter. France is a small net-exporter. In total, the four opt-out countries have a growing import demand. For rapeseed meals the four opt-out countries are net-exporters of 1.8m tonnes. This indicates that rapeseed meal is available for (partial) substitution of soy. The trends for both products indicate little changes until 2020: slightly more seeds imports and less meals. The net-import of rapeseed is on the same level as soybeans. The level of meals are just above 1m tonnes imports for the rest of the EU and 1m tonnes export of the four opt-out countries.

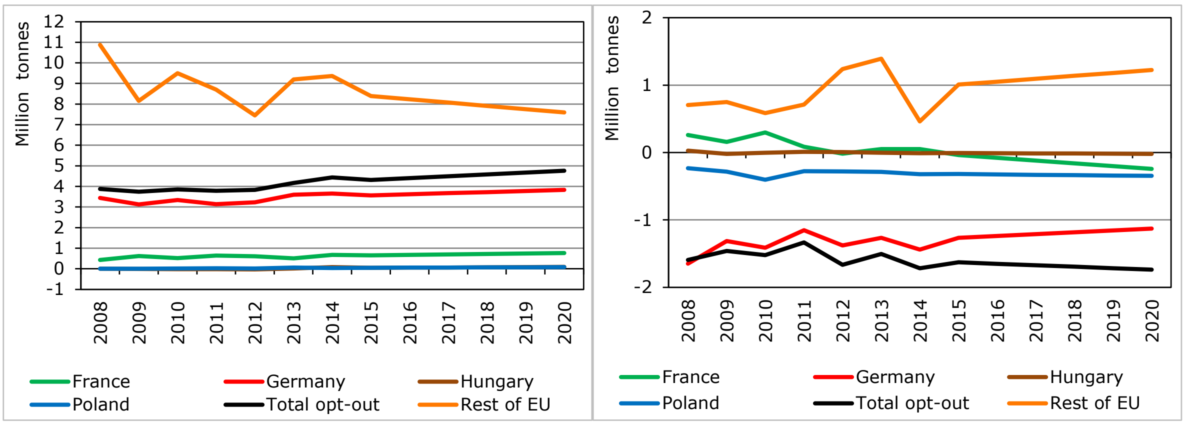

Figure 2.3 *Net import of rapeseeds and rapeseed meal a) b)*
Missing data for 2014 are filled in by 2013 quantities; b) Net import is import minus export.
Source: Based on UN Comtrade.

World trade in rapeseed

To estimate the availability of non-GM rapeseeds on the world market the same approach as for soybeans was performed. According to GMO Compass, 24% of the worldwide rapeseed production is GM rape, with a focus on Canada (93%) and the USA (94%). Especially Canada is a large producer with 47% share in the worldwide trade of rapeseed. Because almost all rapeseed from Canada and the USA are GM, the risk of commingling GM and non-GM rapeseed is high. It is unlikely that non-GM rapeseeds or meals available in Canada can be exported as non-GM to the EU. The available amount of non-GM rapeseed on the world market is estimated at 9.3m tonnes (Table 2.7). This is 6.0m tonnes above the net-import of the four opt-out countries of 3.3m tonnes (Table A2.3). About 20% of the available non-GM rapeseed originate from the three opt-out countries France, Hungary and Poland. Furthermore, several other EU Member States and Ukraine are net-exporters as well. The additional available 6.0m tonnes of non-GM rapeseed is equivalent to 3.4m tonnes of rapeseed meal (assuming 55% meal from seeds).

Table 2.7

Rapeseeds trade per country, total export and estimated available non-gm export (m tonnes in 2014) and annual growth in the years 2009-2014 (%) of largest exporting countries and rest of the world a)

Country	Export		Import		Available net export	
	Volume	Growth	Volume	Growth	Total Volume	Volume non-GM
Total	20.4	5.8	22.2	7.1		9.3
Canada	9.7	4.9	0.1	-12.5	9.7	0.7
Australia	2.4	16.8	0.0	10.1	2.4	2.4
Ukraine	2.0	1.9	0.0	7.7	2.0	2.0
France	0.9	-5.5	0.9	4.2	0.0	0.9
The Netherlands	0.9	27.8	1.6	-5.4	-0.7	
Belgium	0.7	155.0	2.7	8.8	-2.0	
Hungary	0.6	6.4	0.1	51.2	0.5	0.6
Czech rep.	0.4	-0.8	0.1	43.5	0.3	0.4
Romania	0.4	8.6	0.0	-10.6	0.4	0.4
Poland	0.3	10.9	0.2	-12.9	0.2	0.3
Lithuania	0.3	-1.4	0.0	-43.4	0.3	0.3
United kingdom	0.3	11.7	0.1	-28.1	0.2	0.3
Germany	0.2	-5.7	4.2	5.1	-4.0	0.0
Rest of world	1.3	0.4	12.3	12.4	-11.0	1.0
4 opt-out countries	2.0	-0.8	5.3	4.2	-3.3	1.8
Rest of EU	3.6	11.4	5.4	10.2	-1.8	2.0
Total EU	5.6	6.1	10.7	6.9	-5.1	3.8

a) missing data for 2014 are filled in by 2013 quantities (e.g. the Netherlands). Totals may not add due to rounding and different years.

Source: Based on UN Comtrade.

Trade in rapeseed meal

Consistently with the approach for soybeans, only net-export is taken from countries that have a net-export in both rapeseed and rapeseed meal and not being an opt-out country. The amount of non-GM rapeseed meal available on the world market is estimated at 1.3m tonnes (Table 2.8). This is excluding the net-export of 1.7m tonnes of rapeseed meal of the 4 opt-out countries. This amount is not differentiated between GM and non-GM. Germany is a large net importer, but an exporter of meal. The exported meal (in this example from Germany) is not taken into account as it might be based on GM–rapeseeds. Poland is a net-exporter of both seeds and meals and in this case the export amount is added to available volume. If all imported rapeseeds will be non-GM, the German amount will be non-GM rapeseed meal. In that case that amount can be regarded as direct available for substitution at the domestic market. In the impact assessment we included this domestic available non-GM rapeseed in the opt-out countries.

Table 2.8
Rapeseed meal trade per country, total export and estimated available non-gm export (m tonnes in 2014) and annual growth in the years 2009-2014 (%) of largest exporting countries and rest of the world a)

Country	Export		Import		Available net export	
	Volume	Growth	Volume	Growth	Total Volume	Volume non-GM
Total	8.3	6.5	6.7	5.5	1.6	1.7
Canada	3.5	14.6	0.0	34.6	3.4	0.2
Germany	1.8	2.4	0.4	4.8	1.4	
Belgium	0.5	1.6	0.1	-20.0	0.5	
France	0.4	11.5	0.4	3.0	-0.1	
Poland	0.4	4.9	0.0	59.6	0.3	0.4
India	0.3	81.8	0.0		0.3	0.3
Czech Rep.	0.2	6.2	0.1	9.5	0.2	0.2
Romania	0.2	38.6	0.0		0.2	0.2
United Kingdom	0.1	-7.7	0.2	-6.9	0.0	
Pakistan	0.1	83.5	0.0		0.1	
Ukraine	0.1	77.1	0.0	-41.7	0.1	0.1
Hungary	0.0	9.1	0.0	25.7	0.0	0.0
Rest of world	0.6	-14.0	5.5	6.6	-4.9	0.2
Total 4 opt-out	2.6	4.0	0.9	5.3	1.7	0.4
Rest of EU	1.4	-1.8	1.9	-4.0	-0.1	0.5
Total EU	4.0	1.7	2.8	-1.5	-0.1	0.9

a) missing data for 2014 are filled in by 2013 quantities.

Source: Based on UN Comtrade.

2.3.3 Trade in sunflower seeds and meal

The four opt-out countries

The four opt-out countries together are net importing 0.2m tonnes of sunflower seeds (Table A2.5). Germany is the largest net-importer. France and Hungary are net-exporters, however with a decreasing level of net-exports from Hungary. For sunflower meal the four opt-out countries are net-importers of 1.2m tonnes (Table A2.6). Figure 2.4 shows that the net-import of sunflower seeds for the four opt-out countries is expected to grow the coming years, but this is outnumbered by the increasing net-export of the rest of the EU. For sunflower meal the net-import trend is positive, both for the opt-out countries and the rest of the EU. The volumes of sunflower trade are small compared to the soy products.

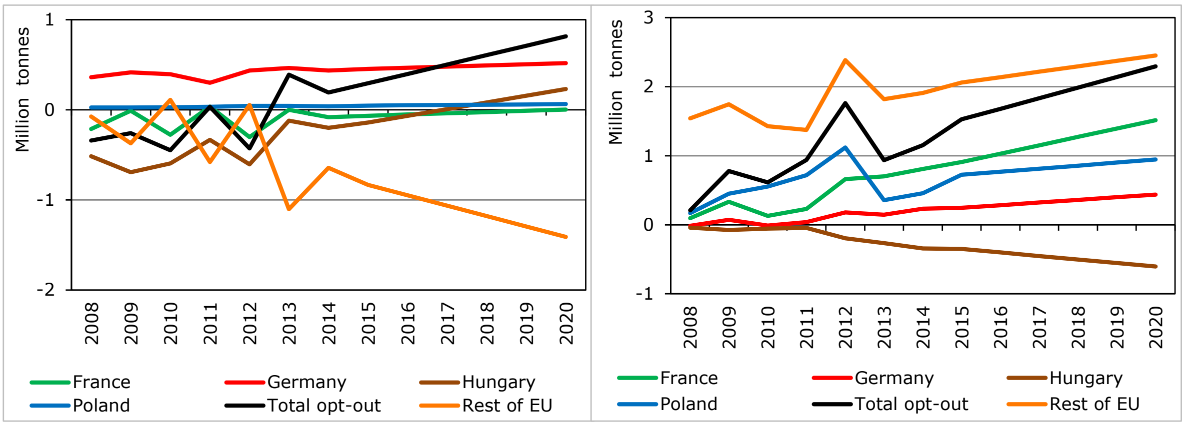

Figure 2.4 *Net import of sunflower seeds and meal a)*
a) Net import is import minus export.
Source: Based on UN Comtrade; missing data 2014 are filled in by 2013 quantities.

Trade in sunflower seeds

All sunflower seeds are non-GM, hence all sunflower seeds are potential substitutes. The world export of sunflower seeds is estimated at 4.8m tonnes (Table 2.9). About 20% of these supplies originate from Hungary and France. The demand from the four opt-out countries amounts to 0.2m tonnes. Furthermore several other EU Member States are net-exporters as well as the EU neighbouring country Moldova. This export exceeds the current import needs of the four opt-out countries by 4.6m tonnes, which is equivalent to 2.6m tonnes of sunflower meal (assuming 55% meal from seeds).

Table 2.9

Sunflower seed trade per country, total export and estimated available non-gm export (m tonnes in 2014) and annual growth in the years 2009-2014 (%) of largest exporting countries and rest of the world a)

Country	Export		Import		Available net export	
	Volume	Growth	Volume	Growth	Total Volume	Volume non-GM
Total	4.8	0.3	4.6	2.2	0.3	4.5
Romania	1.3	18.6	0.1	-3.4	1.2	1.3
Bulgaria	0.9	-2.8	0.0	31.1	0.8	0.9
Hungary	0.5	-8.4	0.3	57.9	0.2	0.5
France	0.4	5.5	0.4	1.8	0.1	0.4
Moldova	0.2	17.0	0.0	31.8	0.2	0.2
Slovakia	0.2	13.7	0.0	-2.5	0.2	0.2
China	0.2	7.6	0.1	93.9	0.1	0.2
Kazakhstan	0.1	115.8	0.0	-26.3	0.1	0.1
USA	0.1	-4.6	0.1	-0.5	0.1	0.1
Rest of world	0.8	-13.4	3.6	1.0	-2.8	0.4
Total opt-out	0.9	-2.8	1.1	6.5	-0.2	0.9
Rest of EU	2.7	6.5	2.1	5.2	0.6	2.5
Total EU	3.7	3.6	3.2	5.6	0.5	3.4

a) missing data for 2014 are filled in by 2013 quantities.

Source: Based on UN Comtrade.

Sunflower meal

On the world market, about 7.9 tonnes of sunflower meals are available, of which 0.7m tonnes from the opt-out countries (Table 2.10). As 1.2m tonnes is already imported by the four countries (Table A2.6), this has to be deducted from the total net export, resulting in 6.7m tonnes net available sunflower meal, additional to current import flows. The maximum additional sourcing of sunflower product is calculated at 9.3m tonnes of sunflower meal equivalent, from seeds and meal together.

Table 2.10

Sunflower meal trade per country, total export and estimated available non-gm export (m tonnes in 2014) and annual growth in the years 2009-2014 (%) of largest exporting countries and rest of the world a)

Country	Export		Import		Available net export	
	Volume	Growth	Volume	Growth	Total Volume	Volume non-GM
Total	7.9	5.9	7.4	6.6		6.9
Ukraine	3.8	8.9	0.0	-14.0	3.8	3.8
Russia	1.4	5.2	0.0	92.2	1.4	1.4
Hungary	0.4	24.3	0.0	-10.8	0.3	0.4
Netherlands	0.3	8.4	0.5	9.0	-0.2	
Argentina	0.3	-16.9	0.0		0.3	0.3
Romania	0.3	15.9	0.0	16.4	0.3	0.3
Bulgaria	0.2	17.2	0.0	93.1	0.2	0.2
France	0.2	-1.8	1.0	14.0	-0.8	
Germany	0.1	1.8	0.3	14.4	-0.2	
Rest of world	0.8	4.3	5.6	5.2	-4.7	0.5
Total 4 opt-out countries	0.7	10.7	1.8	9.0	-1.2	0.4
Rest of EU	1.2	11.1	3.1	4.9	-1.9	0.6
Total EU	1.9	10.9	4.9	6.3	-3.1	1.0

a) missing data for 2014 are filled in by 2013 quantities (e.g. the Netherlands).

Source: Based on UN Comtrade.

2.4 Compound feed

Compound feed production

The compound feed production in the 4 opt-out countries for the different animal categories are given in Table 2.11. Total production is 54.5m tonnes.

Table 2.11

Compound feed production in the opt-out countries per animal category in 2014 (1,000 tonnes) a)

Animal species		Germany	France	Poland	Hungary
Cattle		7,157	5,515	970	565
Of which:	Dairy cows	6,652	3,367		
	Other cattle	505	2,148		
Pigs		9,694	5,146	1,900	1,345
Of which:	Piglets	1,785	744		
	Breeding pigs	1,190	872		
	Other pigs	6,719	3,530		
Poultry		6,230	8,680	5,750	1,565
Of which:	Broilers	2,730	3,264		
	Laying hens	2,202	2,415		
	Other poultry	1,298	3,001		
Total		23,081	19,341	8,620	3,475

a) Other feed, e.g. for sheep, goats or petfood is not shown here and not taken into account in the analysis.

Source: FEFAC (2015).

Soy content in compound feed
Soybean meal is an important ingredient for compound feed, as a source of proteins. The amount of soy in compound feed varies between animal types. Data about the content per type of compound feed in the different EU member states is scarce. Hoste (2014) estimated an average soybean meal content of 10.9% for compound feed in the Netherlands. Based on the soy contents in the Netherlands, the total estimated amount of soybean meal equivalents used in compound feed in the 4 opt-out countries would amount to 7.2m tonnes, the actual use however, amounts to 10.1m tonnes of soybean meal equivalents. This originates from 4.4m tonnes net import of soybeans plus 0.2m tonnes domestic production, which is equivalent to 3.5m tonnes meal, and 6.4m tonnes net soybean meal import (Table 2.1).

An explanation of this gap is the fact that a significant part of farms perform home-mixing of feed, based on a combination of own cultivated crops and purchased concentrates including e.g. soy and vitamins, rather than buying compound feed (Tallage, 2009). Based on Tallage (2009) it is estimated that the total feed production (industrial + on farm) is almost twice the volume of the total industrial production in these four countries, with 51% industrial feed in Germany, 61% in France, 37% in Poland and 62% in Hungary. Especially in Poland the home-mixed feed volumes are rather high. The soy use of home-mixing farmers is likely to be lower than in industrial feed. This suits with the finding that almost half of the home-mixed feed is for cattle, rather than for poultry. Also Hoste (2014) found that only some 5% of the total soy use in the Netherlands is directly fed by home-mixing farmers, compared to about 24% estimated home-made feed volumes (calculation based on Tallage). Another explanation could be related to insufficient statistics, especially for Hungary, as the soy contents seem to be underestimated here.

2.5 Supply chain

2.5.1 Soybean processing industry

Soybean crushing and toasting industry
According to data provided by FEDIOL, soybean crush in the four opt-out countries is performed in four plants, one in France, two in Germany and one in Hungary. The crush in Hungary has a relatively low volume and soybean crush is already today only a small part of the activity of that plant. Of the total supply of soybeans in the 4 opt-out countries of 4,759k tonnes, 4,240k tonnes is crushed. In the three crushers in France and Germany about 180 persons are working and annual turnover is about €1.9bn.
According to data provided by FEDIOL, soybean toasting in the four opt-out countries is estimated to be performed in seven plants, two in France, one in Germany, two in Hungary and two in Poland. Of the total supply of soybeans in the 4 opt-out countries of 4,759k tonnes, 339k tonnes is toasted. Annual turnover is about €140m and about 28 persons are working in these seven plants.

Commodity balance and importance of soybeans
The four opt-out countries together are important oil seed processors of the EU: almost half of the EU's total. Germany and France are the main processors. Soy has a share round 30% in the EU oil seed processing as well as in Germany. In France, Hungary and Poland the amount of soybean processing is rather small. The latest available numbers from 2011 show that 90% of the world production of the rapeseed, 85% of the soybeans and 78% of the sunflower seeds are used for crushing (Table 2.12). Since 2011 the production as well as the crushing capacity has increased. Based on Oilworld Statistics, the soy-crushing amount in Germany increased with round 10% between 2010 and 2014, and count for the total growth of the EU soy-crushing volume.

France oilseed crushing industry is essentially (around 90%) based on the processing of locally grown rapeseed and sunflower seeds. In France the share of rapeseed processing is below the world level: if France would process 90% of their rapeseed production, it could process 0.7m tonnes additional. This is slightly above the quantity of processed soybeans. We therefore expect that an opt-out of France will not have a significant impact on the oilseed processing industry in France.

Germany's oilseed processing industry is for 60% based on imported oilseeds: for soybeans even fully. Hence an opt-out can have a severe impact on their industry. However, Germany processes just 25% of the EU soybeans and only 1.3% of world's total.

The processing in Hungary covers mainly sunflower seed for 0.8 m tonnes and is very small in soybeans. Furthermore, Hungary processes very little of their own production of rapeseed, sunflower seeds and soybeans: significantly lower than the world processing shares in production. We therefore expect that an opt-out of Hungary will not have a significant impact on the oilseed processing industry in Hungary.

Poland's processing industry is largely rapeseed based. An opt-out of Poland for GM soybeans will not have a large impact on the oilseed processing industry as soybeans are hardly processed.

Table 2.12

Production and processing volumes (m tonnes) and processing world share (%) of soybeans, rapeseed and sunflower seed in 2011

Product	Activity	EU	France	Germany	Hungary	Poland	World
Soy	Production volume	1.2	0.1	0.0	0.1	0.0	261.9
	Processing volume	12.5	0.6	3.0	0.1	0.0	224.1
	Processing share	5.6	0.3	1.3	0.0	0.0	100
Rape	Production volume	19.3	5.4	3.9	0.5	1.9	63.3
	Processing volume	20.7	4.2	6.7	0.0	2.0	57.3
	Processing share	36.1	7.3	11.6	0.0	3.5	100
Sunflower	Production volume	8.5	1.9	0.1	1.4	0.0	40.8
	Processing volume	6.7	1.5	0.3	0.8	0.0	31.7
	Processing share	21.3	4.6	0.8	2.4	0.1	100
Sum of soy, rape and sunflower	Production volume	29,0	7,4	4,0	2,0	1,9	366.0
	Processing volume	40.0	6.3	9.9	0.8	2.1	313.1
	Processing share	12.8	2.0	3.2	0.3	0.7	100

Source: FAOstat, food balances.

Economic performance of oilseed processing industry

The gross operating margins in the oilseed processing industry are thin. These thin margins offer little opportunities for a lower utilisation of the plants. An insufficient supply of raw materials will result in a shutdown of plants in the long run. Because of these low margins, additional costs are difficult to absorb by the crushing sector. If increasing raw material cost cannot be passed on to the buyer, a crusher may have to decide to stop its activity.

Table 2.13

Turnover (billion euros in 2012) and gross operating surplus as % of turnover (average of 2008-2012; and 2012) of the edible oil industry

Country	Turnover	Gross operating surplus/turnover	
		Average 2008-2012	2012
EU	55.5	a)	a)
France	8.1	1.7	2.1
Germany	7.3	2.1	1.1
Hungary	0.8	4.7	4.1
Poland	1.5	2.7	6.3
Spain	10.8	1.0	5.6
Netherlands	8.3	1.6	0.6

a) no data available. These figures are not limited to soy, rape or sunflower meal crushing.

Source: Eurostat SBS.

2.5.2 Animal feed industry

The total turnover in the animal feed industry in the EU amounts to €77.5bn (Table 2.14). France, Germany and Spain have a substantial share in this total. Gross operating surplus as share of the total turnover varies clearly between countries.

Table 2.14
Turnover (billion euros in 2012) and gross operating surplus as % of turnover (average of 2008-2012; and 2012) of the feed industry.

Country	Turnover	Gross operating surplus/turnover	
		Average 2008-2012	2012
EU	77.5	a)	a)
France	13.0	4.2	4.3
Germany	10.8	6.5	6.5
Hungary	1.1	6.7	5.6
Poland	4.1	8.4	7.2
Spain	10.1	4.8	5.3
Netherlands	8.1	5.1	6.0
UK	8.5	13.8	13.3

a) no data available. Turnover data includes petfood production.

Source: Eurostat SBS.

2.5.3 Animal production

The animal production sector covers about 1.7bn cattle, pigs, chickens, sheep and goats (Table 2.15), of which about 80% is chickens.

Table 2.15
Number of farm animals in four opt-out countries and the EU as a whole in 2013 (m animals)

	Germany	France	Poland	Hungary	EU total
Cattle	12.6	19.1	5.9	0.8	88.3
Pigs	27.7	13.5	11.2	3.0	147.0
Chickens	161	168	124	30	1,339
Sheep and goats	2.0	8.5	0.3	1.3	110.2

Source: FAOStat.

2.5.4 Meat processing

The total turnover in the meat processing industry in the EU amounts to €217bn (Table 2.16), with France and Germany as major contributors. Gross operating surplus as share of the total turnover varies clearly between countries, somewhere between 2 and 7%.

Table 2.16
Turnover (billion euros in 2012) and gross operating surplus as % of turnover (average of 2008-2012; and 2012) of the meat industry

Country	Turnover	Gross operating surplus/turnover	
		Average 2008-2012	2012
EU	217.0	a)	a)
France	35.5	2.6	1.8
Germany	47.2	4.9	3.3
Hungary	2.7	4.1	3.1
Poland	14.1	3.7	5.5
Spain	21.2	6.8	6.6
Netherlands	23.0	3.7	3.6
UK	20.2	6.5	7.1

a) no data available.

Source: Eurostat SBS.

3 Expected impacts

3.1 Availability of protein substitutes

Key findings:

- Exchanging the current GM soy demand of the four opt-out countries by non-GM protein crops is not impossible, but it will be very difficult requiring a combination of import of a very substantial part of the worldwide available non-GM soybeans and soybean meal, of a reduction in protein use in animal feed of 10%, and of a substitution of at least 20-30% of the currently used soy in animal feed by protein replacers like rapeseed meal and sunflower meal.
- The apparent availability of non-GM soybeans is estimated at 7.0m tonnes and the demand is estimated 4.8m tonnes. This means that about 69%, the so-called tension factor, of the world's availability is demanded for the four opt-out countries (including current non-GM soybean demand in the rest of the EU).
- The current non-GM soybean meal market is insufficient to provide the demand of the four opt-out countries. Including meal out of remaining non-GM soybeans, the estimated apparent availability of non-GM soybean meal amounts to 5.0m tonnes, whereas the demand is estimated at 7.4 m tonnes.
- The total estimated demand of 7.4m tonnes can be reduced to 3.3m tonnes of soybean meal by application of efficiency measures and substitutes. A substitution of at least 20-30% of soybean meal by protein sources like rape or sunflower is necessary.
- With a substitution of 20-30% of soybean meal by other protein sources, 15-22% of the available non-GM rape and sunflower meal at the world market is needed to fulfil the protein balance requirements).

In Section 2.3 we assessed the opportunities to substitute the current amount of 8.4m tonnes GM soybean meal equivalent used in the four opt-out countries. In this Section the supply and demand of soybeans, soybean meal and substitutes is shown and opportunities are assessed on whether or not it is possible to find a solution in the medium term in the situation that the 4 countries apply an opt-out of the use of GM soybeans and GM soybean meal in animal feed. To do so, we developed balances of the amounts of non-GM soybean and soybean meal demanded by the four opt-out countries and the other EU Member States and the availability on the world market of these commodities and the most important substitutes: rapeseed and sunflower seed. The most important assumptions for these balances are:

- Current non-GM soybean import into the EU and current domestic soybean production is assumed to not be available for animal feed; volumes of other uses, including for seed and food are assumed to not change;
- Remaining non-GM soybeans on the world market are available for animal feed, be it as soybeans or soybean meal;
- A 10% reduction of protein demand on country level is possible, due to feeding management optimisation, reduction of crude protein content in the feed and increased digestibility of crude protein by feed fermentation, probiotics or enzymes (Griep and Stalljohann, 2014). This reduction is calculated over the total non-GM soybean meal demand in the 4 opt-out countries and the rest of the EU;
- Substitution of soybean meal in animal feed is assumed to different degrees, from 20% substitution (Le Cadre and Pressenda, 2015) to 50% (van Wagenberg and Hoste, 2015), with a price premium for non-GM soybean meal of €75 to € 150;
- Calculated soy substitution by rape or sunflower is based on maintaining an equal ileum digestible lysine level in animal feed (Table 2.5). A substitute conversion ratio to soybean meal of 2.08 is assumed, based on 75% rapeseed meal and 25% sunflower meal;
- Total animal production and feed demand in the EU is constant;

- An increase of non-GM protein crop production in Ukraine of 1m tonnes of soybeans, 1m tonnes of rapeseed, and 2m tonnes of sunflower seed is projected (see Appendix 3). Non-GM soybean production in the EU is projected to increase with 1m tonnes.

Soybean
The current total world net export of non-gm soybeans amounts to 8,600k tonnes (Table 2.3), which theoretically is available on the world market for filling the arising gap. However, in practice this volume will likely not be fully available for import into the EU, for example because non-GM soybean will be mingled with GM soybean at or just after harvest, since locally there may not always be an economic interest to distinguish GM and non-GM commodities, or because the contamination with GM soybean or another GM commodities exceeds the 0.9% threshold of the EU for commodities to be imported as non-GM, or because volumes are destined for food use. We assumed that non-GM soybeans from the USA, Canada, Paraguay and India will not be available for the EU. Therefore, in the calculations we estimated an amount of 5,000k tonnes to be actually available in the medium term, which we call 'apparently available'.

Next to the availability based on the current supply on the world market, an expansion of the non-GM soybean production is projected in Ukraine (see Appendix 3) and the EU, of each 1m ton. In the other countries where non-GM soybeans are cultivated, we assumed that the production of non-GM soybeans remained equal in volume. Given the assumed increase of the premium for non-GM soy, this is a conservative assumption. Assuming that the 1m ton expansion in Ukraine is fully non-GM, the total (apparent) availability in the medium term would thus amount to 7,000k tonnes.

The current demand of non-GM soybeans amounts to 515k tonnes in the 4 opt-out countries and 400k tonnes in the rest of the EU (Table 2.1). If the current GM soybean demand of 3,924k tonnes (Table 2.1) is replaced by non-GM soybeans, the total demand for non-GM soybeans amounts to 4,839k tonnes.

From the availability (7,000k tonnes) and the demand (4,839k tonnes) we derive the so-called tension factor, being the share of the demand volume in the availability volume. This tension factor amounts to 69% (4,839 / 7,000), which means that a major share of the apparently available soybeans will be needed to fulfil the demand in the new situation. This suits with the assumed firm increase of the non-GM premium. The remaining 2,161k tonnes of soybeans (7,000m to 4,839m tonnes) are a potential source of non-GM soybean meal.

Soybean meal
The current total world net export of non-gm soybean meal amounts to 4,000k tonnes (Table 2.4). Comparable to the situation with soybeans, this amount is likely not fully available. We assumed an amount of 3,300k tonnes apparent availability of non-GM soybean meal from the world market. Additionally soybean meal of the remaining 2,161k tonnes soybeans is available, which equals 1,696k tonnes soybean meal. This brings the total apparent availability of non-GM soybean meal to 4,996k tonnes.

The current demand of non-GM soybean meal in the 4 opt-out countries amounts to 898k tonnes and in the rest of the EU 945k tonnes (Table 2.1). If the current GM soybean meal demand in the four opt-out countries (5,548k tonnes, Table 2.1) would be replaced by non-GM soybean meal, the total EU demand for non-GM soybean meal would thus amount to 7,391k tonnes. This total demand exceeds more than twice the apparent availability of non-GM soybean meal. The total demand surpasses the apparent availability, resulting in a tension factor for soybean meal of 148% (7,391 / 4,996).

However, above numbers assume soybean meal to be used in the same amount in animal feed as in the current situation. Given the high premium for non-GM soy we assume that soy use will be diminished, both by reduction and substitution. A reduction opportunity is assumed of 10% soybean meal content, based on Griep and Stalljohann (2014).

Additionally different degrees of substitution of soybean meal in animal feed by rapeseed and sunflower meal were assessed (Table 3.1). Although Le Cadre and Pressenda (2015) do not exceed

20% reduction, Van Wagenberg and Hoste (2015) estimated substitution ratios of 30-50%, based on feed optimisation calculations of Schothorst Feed Research.

It was calculated that after reduction of 10%, a substitution of at least 20-30% is necessary to reduce the tension factor to a level below 100% and be able to fill the gap between supply and demand (Table 3.1).

With these assumptions, at least theoretically, and irrespective of logistics, additional costs or quality requirements, the non-GM protein demand of the four opt-out countries could be satisfied by the current availability of non-GM beans and meal, and substitutes.

The need for substitution will lead to a price increase of the soy substitutes rapeseed and sunflower; the tension factor (the volume of additional demand for substitutes compared to the world total available volume) however, is rather limited, compared to the tension on the soybean meal market. With a substitution of 20-30%, the tension factor for the substitutes amounts to 15-22%.

Table 3.1
Consequences of reduction and substitution of soybean meal on the soy and substitutes' balance (volumes in thousand tonnes, tension factor in %)

Options	Basis	Reduction	Substitution			
Reduction		10%				
Substitution			20%	30%	40%	50%
Total apparent availability	4,996	4,996	4,996	4,996	4,996	4,996
Total demand of non-GM soybean meal in 4 opt-out countries	6,446	5,801	4,641	4,061	3,481	2,901
Total demand of non-GM soybean meal in other EU countries	945	851	680	595	510	425
Total demand of non-GM soybean meal in the EU	7,391	6,652	5,322	4,656	3,991	3,326
Tension factor world market non-GM soybean meal (%)	148	133	107	93	80	67
Soybean meal substituted	0	0	1,330	1,996	2,661	3,326
Substitute demand	0	0	2,772	4,157	5,543	6,929
Tension factor world market non-GM rape and sunflower meal equivalent (%)	0	0	15	22	30	37

In case that other EU Member States would apply an opt-out policy, additional to the four countries assumed in this assessment, the challenge to find a solution for the protein balance will aggravate the problem severely.

3.2 Crushing and toasting industry effects

Key findings:

- No large negative effects for the crushing industry in the four opt-out countries are expected.
- The crush industry in Europe may even see rising volumes, due to increasing European production of soybeans and substitutes.
- Additional costs for oil seeds are expected to be transmitted to meals, rather than to liquid oils.
- Due to a shift in the supply of soybeans from the west to continental cultivation (southeast Europe including Ukraine), crush in seaports in the west of the EU, such as in the Netherlands, may become under pressure.

In the very short run the consequences for the oil seeds processing industry might be serious, like underutilisation of capacity and hence margin reduction due to insufficient supply of raw materials, and loss of profitability, due to higher input prices and little opportunities for transmitting the additional costs to the next actor in the supply chains, which may in turn lead to direct shut-down of plants. However, this also depends on the transition time.

For three reasons we do not expect a large impact on the oilseed crushing industry in the EU and in the four opt-out countries:

1. First, supply of non-GM soybeans in the four opt-out countries can be at least at the same level as the current processing volume. It was argued that additional supply above the present process volume will be available. This suggests that for the soybean crushing and toasting industry in the 4 opt-out countries neutral or positive effects are expected.
2. Second, with the substitution of 20-30% of soy used in animal feed, larger quantities of rapeseed and sunflower meals are needed. A lower amount of soybean meal can have two effects on the crushing industry. As Europe is a net-importer of oil meals, less soy meals and more rape and sunflower meals can be imported. In that case the impact on the crushing industry will be negligible. In the second case, the European industry crushers adapt from soybean crushing to rape and sunflower seed crushing. The protein content in rape and sunflower meal is lower than in soy meal, hence larger volumes meals are needed. This means that the total amount of soybeans, rapeseed and sunflower seed to be crushed for the required meal volumes for animal feed in the EU is expected to increase. The transition of a crushing plant to other seeds requires an investment, as the worm and worm cage are seed specific. However, if combined with a regular maintenance service, the investments are expected to be modest.
3. Third, domestic non-GM soybean production in the (southern) EU and in Ukraine is expected to increase with an additional 1.0m tonnes each. This increases the required capacity for soybean processing. It is reasonable to assume this will happen in the regions where the additional soybean production is expected (southeast Europa and Ukraine), or in the area of final use, i.e. including the opt-out countries. However, transport costs are rather small and are not expected to be limiting for crushers elsewhere in Europe.

In France, Hungary and Poland, domestic production of soybeans, rapeseed and sunflower seeds is at least more or less equal to the crush volume. Therefore, we expect that an opt-out of the four countries will not have an impact on the oilseed processing industry in France, Hungary and Poland. In Germany, crushing capacity exceeds the domestic production of soybeans, rapeseed and sunflower seed. However, the import of non-GM soybeans replacing the current GM soy imports exceeds the crushing capacity in Germany. So, no significant effect on the oilseed crushing industry in Germany is expected either.

Given the expected increase of oil seed production in Europe (including Ukraine), additional liquid oil will become available to the market. This might affect the sales price. However, as we assume implementation of the opt-out policy to require an adaption time, the potential price reduction of liquid oils is estimated to be rather limited, as sales markets will adapt to a new supply balance.

Overall, we conclude that for the processing industry no large impact on crushing quantities is expected. However, transactions cost of securing sufficient oilseed to be crushed and the prices of raw materials will likely increase. Given the limited margins in the crushing industry it is expected that these additional costs are passed on downstream the supply chain of mainly meals: one of the reason to assume significant price increases of meals. Passing down to the edible oil prices is only expected if the opt-out policy includes the supply of edible oil to consumers. However this was not assumed for this assessment.

3.3 Effects for trade and transport in the EU

Key findings:

- No reduction in total volume of trade in the EU
- Seaports in non-opt-out countries may face a reduction in transhipment
- The Netherlands may face a stop of the soybean flow to Germany and a reduction of up to 1.4m tonnes of soybean meal to the four countries.

Under the current assumption the total animal production and the total demand of raw materials for feed production in the EU will remain at a similar level. Therefore we do not expect much impact on the EU trading industry *as a whole*. The total protein balance in the four opt-out countries will change, as the world supply on non-GM soy is more restricted than of non-GM substitutes like rape and sunflower and as saving options are expected.

Import of soybean and soybean meal in seaports is likely to reduce because trade flows shift towards intra-EU production locations and import from countries bordering the EU in the east, such as Ukraine. This is especially relevant for the Netherlands and Belgium, with a large transit of feed materials to other EU countries (especially Germany and France) imported in the seaports of Rotterdam and Amsterdam. The Netherlands could face less transport of soybean and soybean meal. Additional soybean production in the EU and Ukraine is expected to be imported to France and Germany, as to provide local crushing. This will partly be at the cost of German and French harbours, as it will be supplied by truck and/or inland vessels rather than by ocean vessels. It might reduce the amount of soybeans going through the ports of Amsterdam, Antwerp and Rotterdam to these countries, either or not after crushing in these cities. If the crushers in the seaports remain being used, the impact on the trading industry in the countries of these seaports is likely minor.

If *crushing* will move to the production regions of the beans and seeds, then the transport sector in the countries with a seaport could lose part of their trading sector. As a maximum, no beans from the new production regions go towards these countries with a seaport anymore, but directly to the 4 opt-out countries. Because Germany requires 84% of the soybeans going to the 4 opt-out countries, mainly the current exporters to the Germany will be hit. Within the EU, this mainly concerns the Netherlands, which supplied 1.2m tonnes of soybeans to Germany in 2014. Furthermore, the Netherlands exported 1.4m tonnes of *soybean meal* to the 4 opt-out countries.

In total, the *harbours* and *transport sector* in the Netherlands could thus face a reduction in trade volume of up to 2.6m tonnes. For comparison, since most of this soy is transport with inland shipping, and as the inland shipping sector in the Netherlands transported 337m tonnes in 2014 (Statistics Netherlands[4]), the reduction would be around 0.6% of shipped volume. Next to the Netherlands, Belgium may see a similar effect of reducing soy volumes to France, however to a lower extent. We must stress that these negative effects for the Netherlands, Belgium and other countries with seaports is compensated by additional transport elsewhere in the EU from the regions of production, i.e. south-east EU and Ukraine, towards the 4 opt-out countries.

[4] Retrieved 14 July 2015 from http://statline.cbs.nl/StatWeb/publication/?VW=T&DM=SLNL&PA=82514NED

3.4 Feed composition and price effects

Key findings:

- Feed prices may increase with 0.3 to 9.3% by banning GM soy as feed component, with the highest rise for poultry feed. These price increases are based on a premium of €75 and €150 per tonne of non-GM soy product respectively.
- According to French calculations the soy content of feed will be reduced with about 20%; other calculations show higher reduction opportunities of up to 50%.

Non-GM soy is more expensive than GM soy. The price premium fluctuates over time, but showed an increase over time. Between 2000 and 2005 the premium was €5 per tonne, after which it increased to €30 per tonne in 2012 (Martin, 2012) for long term contracts.

The French organisation Cereopa analysed consequences of a ban on GM soy for France in terms of feed composition and price of animal compound feed, using linear programming (LP). They calculated feed compositions for dairy cows, beef cows, pigs and poultry. Poultry was not split into layer hens (egg production) and broilers (meat). Two scenarios depict the bandwidth of possible consequences. In the first scenario, feed composition is being optimised (based on) with a restriction on GM soy products, assuming a price premium of €75 per tonne for non-GM soy compared to GM soy, additional allowance of rapeseed in dairy high protein feed, but no further restrictions in availability of ingredients. In the second scenario, they used a price premium of €150 per tonne of non-GM soy and the other assumptions remained the same. These prices in the scenarios do not take into account the adaptation of the crop production after a substantial price increase. Feed price consequences (Table 3.2) vary between animal types and between both scenarios. Poultry faces the highest feed price increases, because soy contents are high, especially in broiler feed. Price increases of pig feeds are less than 1%, whereas prices of dairy cow feed increase up to about 5%. Based on LP calculations of Schothorst Feed Research in the Netherlands, Van Wagenberg and Hoste (2015) found lower feed price increases for dairy feed of 0.2-0.3% and higher for pig feeds of 0.9-1.7%, depending on the animal type. Poultry was split into laying hens (3.7-5.2%) and broilers (5.5-10.0%), but results for the poultry sector as a whole are comparable. De Boer *et al.* (2014) assessed cost effects of soy replacement starter fattening pigs. A complete substitution of soy by sunflower meal would lead to a 6% higher feed price and substitution by poultry meat-and-bone-meal resulted in a 4.6% price increase. This is in line with the findings of Wagenberg and Hoste (2015).

Table 3.2
Feed price increase (%) of substituting GM soy for non-GM products in two scenarios with different non-GM soy premiums of €75 and €150 per tonne respectively

Animal type	Scenario 1	Scenario 2
Dairy cows	2.5	5.3
Beef cows	0.4	1.7
Pigs	0.3	0.6
Poultry	4.3	9.3

Source: Le Cadre and Pressenda (2015).

Some transnational feed companies apply cross-border capacity optimisation, especially in the Netherlands and Belgium. Those companies will face a strategic decision on separated production lines within a plant for GM and non-GM feed, to be able to supply feed to both opt-out and other countries. According to calculations of a transnational feed company, this would lead to additional costs of about €0.80 per tonne of feed. For the Netherlands alone, as a non-opt-out country, this might lead to additional costs of some €5 to €7m per year.

Assuming that the animal production in Europe will be constant, the total feed production will be more or less constant. No substantial volume effects are foreseen. However, to fulfil the requirements of limiting essential amino acids in animal feed, crude protein content in feed could increase with the substitution of soybean meal by rape and sunflower meal. The requirements will likely not only be solved by adding synthetic amino acids. Thus, it may be expected that substitution will have negative effects on the nitrogen balance, because nitrogen is a main element of protein. On the other hand, the expected reduction of 10% soy is positive for the nitrogen balance. Quantifying the net nitrogen balance effect of this shift in raw material use was beyond the scope of this quick assessment.

3.5 Animal production effects

Key findings:

- Additional costs for industrially produced animal compound feed may increase with about €390m to €845m per year in the four opt-out countries, where the poultry sector clearly has the highest costs.
- France and Germany will see the highest cost increase of each about €140m to €300m per year.
- Increasing costs are expected to put pressure on the competitive position of the animal production sectors; however, this depends on whether costs can be transferred to other stakeholders in the supply chain including consumers.
- Soy producers in the opt-out countries and in the rest of the EU will see increasing sales prices, which is advantageous for them. Hence there will be a profit shift from animal producers to soy producers.

Based on the feed price effects as in Table 3.2, the feed prices in the Netherlands of 2014 and industrial feed production volumes as in Table 2.11, additional feed costs were estimated (Table 3.3). Total estimated additional feed costs vary from €390m to €845m per year for the four opt-out countries. The poultry sector faces the highest additional costs of €295m to €637m per year. France and Germany are expected to see costs rising with to up to about €300m per year and Poland with up to €200m per year. In Hungary the additional feed costs amount to €25 to €55m per year. Pulay (personal communication, 2015) states that additional costs for broiler production in Hungary amounts to €9.5m and another €2m for other species. However no information was available on the assumptions for these calculations.

These costs only refer to industrially mixed animal feed. It is likely that on-farm mixed feed also faces a cost increase for substitution towards non-GM soy; however this was not calculated due to missing information.

Table 3.3
Additional feed costs in two scenario's, per animal category, per country and total (million euros per year), assuming a €75 and €150 per tonne premium for non-GM soy, respectively

	Germany	France	Poland	Hungary	Total 4
Cattle	46-99	25-59	5-12	3-7	81-178
Pigs	8-16	4-9	2-3	1-2	15-30
Poultry	82-177	114-247	77-167	21-45	295-637
Total	136-293	144-315	84-182	25-55	390-845

The higher feed costs is likely to put pressure on the competitive position of the animal production sectors; however, this depends on whether costs can be transferred to other stakeholders in the supply chain including consumers. If livestock farmers would be able to pass on the additional feed costs to consumers, these would pay the additional €390m to €845m annually for meat and livestock-based products. A further analysis of who will bear which part of the burden and how to transfer costs to other stakeholders are beyond the scope of this assessment. It is reasonable to expect at least some loss of competitiveness of the animal production sector, compared to opt-in countries. This could then result in some shift of animal production towards opt-in countries. However, substantial shifts of animal production typically require long term differences in profitability between regions in the EU, as animal husbandry requires long term investment in for example housing. As long as variable costs are covered and some money is available for private expenses, farmers are likely to continue production in the short and even medium term. A European shift in trade of animal products may occur, in the case that opt-out countries are preferred supplying countries for other opt-out countries, rather than non-opt-out countries.

Table 3.4 provides an estimate of the production cost increase due to higher feed costs. The production cost increase is especially high in poultry (2.6-5.6%) and rather modest in the other animal types. Additional costs were expressed as share of the total cost of production in the primary phase of the supply chain. For these calculations we assumed compound feed costs to be 17% of the total production costs of dairy cows, 15% in beef production, 60% in pig and poultry production (KWIN, 2015). An assessment of cost mitigations within the animal supply chains is beyond the scope of this quick assessment.

Table 3.4
Relative cost increase in the animal production in two scenario's, per animal category (% of costs in the primary production)

Animal type	Cost effect
Dairy cattle	0.4-0.9
Beef cattle	0.1-0.3
Pigs	0.2-0.4
Poultry (broilers and eggs)	2.6-5.6

Soy producers in the opt-out countries and in the rest of the EU will see increasing sales prices, which is advantageous for them. Hence there will be a profit shift from animal producers to soy producers. Farmers with combined animal and soy production are expected to face moderate economic effects. This effect is not further calculated.

3.6 Miscellaneous cross-national consequences

Key findings:

- Several secondary consequences may occur for supply chain participants in other Member States. Export between opt-out and other countries may be subject to shifting trade preferences; this however is not elaborated in detail.

Consequences may occur regarding feed ingredient exports from the opt-out countries towards other Member States. E.g. domestically produced rapeseed meal in Germany will probably stay on their market and therefore no longer be available for import into The Netherlands. Hence the Dutch feed industry will have to find substitutes; this could have consequences for the feed industry and animal production.

Although a national opt-out policy does not a priori mean a ban for meat companies or retailers to sell GM-fed animals and animal products, there may come a shift towards additional sales within non-GM fed animal product programs. This would alleviate the competitive disadvantage for the supply chain participants in such programs. Producers in countries like the Netherlands, Denmark and Belgium, exporting live animals to e.g. Germany, France and Poland might be forced to follow the opt-out practice, if retailers or meat processors in opt-out countries would require this.

Some European retail organisations are currently in the transition towards voluntary non-GM fed animal products programs already, like in Germany and Italy. Such retailers in an opt-out country would potentially lose their distinguishing characteristics. Italian retailers however, currently leaning on Danube soy, will face additional costs as non-GM soybean meal is expected to become more expensive. Consequences for German and Polish producers and meat companies regarding imported piglets and slaughter pigs are unclear, but demands regarding non-GM feed used for those animals in the supplying countries are conceivable. This effect however is not further elaborated.

4 Conclusions and discussion

4.1 Conclusions

1. It will be a serious challenge to fulfil the protein demand for animal feed in the medium term period (3-5 years) in case of an opt-out policy of Germany, France, Poland and Hungary, while keeping their animal production on the same level.
   To provide sufficient quantities of non-GM protein soybeans for animal feed in these countries, about 70% of the expected availability of non-GM soybeans would be needed. To provide the soybean meal demand for animal feed, a combination of measures is necessary, i.e. meal out of remaining beans, feed saving measures and application of protein substitutes.
   This strategic decision would lead to a fierce tension on the world market for non-GM soybeans, and non-GM soybean meal.

2. No significant negative effects for the crushing industry in the four opt-out countries are expected. The crush industry in Europe may even see rising volumes, due to increasing European production of soybeans and substitutes. Additional costs for oil seeds are expected to be transmitted to meals, rather than to liquid oils.

3. Total trade of animal feed ingredients is likely to be constant. However, European trade will face a shift from import through seaports at the west to sourcing from the east, related to increased production of non-GM soy and substitutes in south-east Europe. This may hurt the transhipment sector in countries with seaports, such as the Netherlands and Belgium, and promote transport activities in the Eastern part of Europe.

4. Non-GM soy is expected to become more expensive. Feed prices will face increases of 0.3 to 9.3% by banning GM soy as feed component, with the highest increase for poultry feed.
   These increased feed prices will lead to additional production costs in industrially produced compound feed of about €390m to €845m per year in the opt-out countries, which equals about 2.5% of the total feed costs. France and Germany will see the highest cost increase of each about €140 to €300m per year.
   Increasing costs are expected to put pressure on the competitive position of the animal production sectors in these opt-out countries; however, this depends on whether costs can be transferred to other stakeholders in the supply chain, including consumers.

5. In case that other EU Member States would apply an opt-out policy, additional to the four countries assumed in this assessment, the challenge to find a solution for the protein balance will intensify severely.

4.2 Discussion

In this study, it was assumed that a national ban on use of GMOs only refers to use in animal feed (soy for human consumption was left out of consideration). A situation is conceivable where nations or private initiatives would like to ban products of animals being fed GM crops. This would result in additional consequences, also for Member States currently exporting animal products to the countries implementing an opt-out.

The increased cost of production in the opt-out countries are expected to weaken the competitive position of participants in the supply chain. It is assumed that domestic retailers in the opt-out countries are able to buy animal products of GMO-fed animals in the non-opt-out countries and not being forced to only buy domestically from non-GMO-fed animals. That means that local supply chains in the opt-out countries face higher production costs without a priori higher sales prices, thereby loosing competitive position to supply chains in other EU countries. However, private initiatives aiming to distinguish in the retail market, like in Germany already now, may be able to sell products to a higher price; in that case the additional costs can even be transferred to consumers. Private retailer initiatives outside the opt-out countries may even worsen the scarcity of non-GM soy.

Exporting opt-out countries will face a problem to transfer their higher costs of production to buyers in other countries (within the EU and outside). Of the four opt-out countries in this study, especially Germany is a major importer and exporter of live animals and animal products. For example, Germany imports piglets from Denmark and piglets and slaughter pigs from the Netherlands and exports pig meat both within the EU and outside. It is unclear whether this would still be possible within the scope of the EC proposal. If this would be prohibited, the fattening farmers would face a deficit in piglet supply and not be able to produce. The same holds for other meat, eggs and dairy products. This disadvantage in export opportunities could lead to serious loss of competitiveness of producers in the opt-out countries, which in turn is likely to be an advantage for other EU Member States. Therefore, Schmitz *et al.* (2015) recommend to prevent a solo effort of Germany but to focus on a joint action of the EU as a whole, which would prevent discrimination of particular Member States. However, if the entire EU would ban GM crops for animal feed, the availability of non-GM crops would be far be insufficient for the animal feed production.

As stated before, some loss of competitiveness of the animal production sector, due to higher feed costs, may be expected. Although substantial regional shifts of animal production typically happen very slowly, the potential large and long-term differences in profitability between opt-out and other countries in the EU may compel farmers to stop production. In that case, the demand for non-GM soy and substitutes would be reduced; hence, as the market tension will be reduced, the expected price premium for non-GM soy will decline. If this would happen, a new market balance will happen, with a reduced animal production volume and somewhat lower additional costs. However, a smaller domestic production will also have effects on the feed suppliers and meat industry, as their production volume will be affected as well. This possible effect was not further quantified.

In this assessment we focus on the consequences in the medium term (3-5 years). In the short term serious turbulences may be expected in a search to reduce and substitute soy, in non-GM soy import volumes and in protein crop production, as well as in a search for new nutritional compositions. It is unrealistic to expect that existing available non-GM volumes, which are already directed towards other parts of the world, including EU opt-in countries, will be re-directed only to the 4 opt-out countries from one day to another. In the short term, as non-GM soy is expected to show a fierce upward price trend and limited availability, situations may occur where feed quality is becoming under pressure, which is likely to be accompanied with performance losses in the animal production and a reduction in the number of animals. The scale of the consequences of an opt-out policy will be related to the implementation strategy. Given the expected challenging non-GM protein balance in the opt-out situation, a quick transition would cause far heavier trade distortions than with a moderate transition; this is supported by Le Cadre and Pressenda (2015) and Schmitz *et al.* (2015). A moderate transition path will support traders, shipping offices, transport companies, feed companies, farmers, processors, retailers and other supply chain partners in their for process adaptation, which is expected to alleviate economic consequences.

Assumptions on availability of ingredients, price premiums and substitution opportunities are important determinants in the differences between the outcomes of the assessments of Cereopa (Le Cadre and Pressenda, 2015) and Van Wagenberg and Hoste (2015). This means that results of this assessment are merely indicative. The assumption of the Cereopa study, that a maximum of 0.8m tonnes non-GM soybean meal would be available, is not a correct starting point for the assessment of consequences of a ban on GM crops in animal feed in the medium term. A firm increase of the demand of non-GM soy will lead to higher prices and hence very likely to a more attractive cultivation, resulting in an increasing availability. Therefore limited availability of non-GM crops should be assessed, rather than a starting point of the assessment of consequences. Besides, apart from reduction opportunities on sector level, Van Wagenberg and Hoste (2015), based on Schothorst Feed

Research calculations estimated substitution opportunities of 30-50%, far higher than the French study assumes.

It was concluded that no significant negative effects are expected for the crushing industry in the four opt-out countries, as it is estimated that the required crush volumes will be at least equal to the current volumes. However, substitution of soy by other protein crops than rape or sunflower, e.g. beans and peas would not require a crush. Hence the consequences for the crush industry volumes will be influenced by the substitutes' choice for soy.

As explained in the methodological considerations in Section 2.2, this approach for the protein availability is rather conservative, as availability of non-GM crops was based on net-export figures per country, of countries that export both beans/seeds and meal and we applied an estimated correction to reflect current limitations in practical availability, due to technical and traceability reasons.

We assume that these technical limitations can be bypassed, at least to some extent, as we consider the medium term consequences and assumed a rather firm price increase for non-GM soybeans and meal. In the longer run with the indicated price incentive, trade flows will adapt to the 'new reality' and IP certification will be implemented to exploit the opportunity of higher prices in the opt-out countries. In fact a significant large quantity of non-GM product will be offered to the opt-out countries. The quantity can easily be doubled even if only non-GM soybeans are used for food and only over-surplus (production minus domestic utilisation) is offered on the world market.

We assessed only consequences for soy supply. It is conceivable that an opt-out policy would also include GM corn and rapeseed. However the non-GM worldwide availability of both products is far bigger and hence will lead to less tension on the market than with soy.

Regarding the availability of non-GM soybeans and meal we assumed no expansion of the cultivation outside Europe. The demand for soy in e.g. China increases substantially, which in practice is filled with GM soy. This attractive sales market is expected to stimulate GM soy production in main cultivation areas, rather than focussing on a – from a global perspective – rather limited demand for non-GM soy in some European countries. We did not include an increasing share of GM soy production worldwide. If this occurs, it may impede the availability of non-GM soy. The rather limited demand for non-GM soy might discourage efforts by producers and traders in exporting countries to invest in segregating non-GM and EU-approved GM material (Nowicki *et al.*, 2010). On the other hand, the productivity of non-GM soy cultivation in tonnes per hectare is expected to increase slightly.

Current premiums of non-GM soy amount to some €30 - €60 per tonne. Due to the nature of a quick scan, a premium level had to be assumed, rather than be calculated. We adhered to the Cereopa assumptions on non-GM premiums of €75 and €150 per tonne. These levels reflect the expected limited availability on non-GM soy, but also the fact that segregation costs are likely to increase due to the increasing number of commercial GM events, as Nowicki *et al.* (2010) state. Still it is assumed that these high premiums are sufficient to find solutions for current technical and traceability restrictions, and are an attractive incentive for soy producers to produce non-GM soy.

Le Cadre and Pressenda (2015) and Van Wagenberg and Hoste (2015) assumed only a premium for non-GM soy, not for substitutes. In practice, the price for substitutes is expected to show an increase corresponding to the price increase of non-GM soy. It is likely that a price effect with the substitutes is more or less equal to the price effect in soy, after correction for differences in protein quality. This means that the estimated additional costs of an opt-out policy in this assessment are underestimated. For a more detailed assessment of price consequences, availability of protein crops and substitution effects, calculations have to be performed with a general equilibrium model on world production, trade and demand of feed and food ingredients.

In practice several kinds of beans and peas, or other leguminosae, but also cereals like wheat or barley are used for protein supply in animal food. However, as we performed only a quick assessment we limited to rape and sunflower as soy substitutes. As the study shows, availability of soy substitutes is not the main problem and expanding with other substitutes wouldn't probably change the results of this study.

An expansion of soy production in Ukraine and the EU is projected. This corresponds to some degree with Jansen *et al.* (2010), who analysed a scenario with a sudden doubling of the price of soybeans. As a consequence, they expect in the long term a doubling of the production area of protein crops in the EU and reduction of cereals area by 3%. This supports the assumption that soy production in the EU will increase with increasing demand for non-GM protein crops. According to Bittner (2015) the Danube soy production (including Ukraine) could be increased with more than 5m tonnes of soybeans, to 8-10m tonnes of soybean meal. This is far higher than the projected 1m tonnes of soybeans from the EU and another 1m tonnes from Ukraine that were used in the soy balance. The Ukrainian soybean production increased over 1m tonnes already from 2013 to 2014 (Ukrstat.org), although this includes GM soy. Bittner mentions two conditions for the expansion: productivity improvement and a more attractive subsidy framework.

Support of the European protein crop production for animal feed, e.g. by subsidies, as recommended by Schmitz *et al.* (2015), might be helpful to attain a quick transition towards a higher self-sufficiency of non-GM soy and soy substitutes in the EU, and to alleviate the current non-GM soy scarcity. Expansion of the use of novel protein sources in animal feed such as insects and sea weed, or reallowance of processed animal proteins as an ingredient for animal feed could lower the dependency on imported soy for the animal feed sector in the EU as well. However it is not expected that novel proteins are available sufficiently in the medium term. Consumers' acceptance of processed animal proteins in animal feed might be limited in some European regions, which is relevant for its protein substituting potential.

In our calculations we assumed a reduction opportunity of protein use in animal feed of 10%. A very strict reduction of soy/protein contents could be accompanied with performance losses in the animal production, which we don't expect to happen with the given reduction and substitution options. Griep and Stalljohann (2014) state that a total potential reduction of 0.8 to 1.5m tonnes of soybean meal can be saved on a total use of 2.4m tonnes in pig feed in Germany. This is recalculated to a savings potential of 33-62% in pig feed. The authors state that 15–37 %-point of this reduction is based on optimisation of the feeding regime and substitution. Optimisation of the feeding regime contains measures including extensive phase feeding, reduction of crude protein content in the feed and increased digestibility of crude protein by fermentation, probiotics or enzymes. Soy reductions are especially possible in the feed for finishing pigs. We used the outcomes of this study however quite restrictive, for some reasons: a) Griep and Stalljohann only focussed at pig feed, b) phase feeding requires investments by the farmers, and c) as differences in transition speed between farmers are expected to be high, resulting in a quite slow transition in practice. Therefore the applied moderate reduction opportunity is likely to be possible for dairy and poultry farmers as well; reduction opportunities may appear to be higher in practice. The declining trend of total soy import (beans plus meal) supports the reduction and substitution opportunities of soy in the calculations.

Part of the soy use in animal feed will be fed directly or mixed on the farm. Therefore is was not possible to calculate soybean meal contents in compound feed, nor to compare it between the countries assessed. Hence the reduction opportunities might be different between countries. For France however, being one of the opt-out countries, it was assessed that soybean meal contents of animal feed (separately per animal category) are probably comparable to those in the Netherlands.

The on-farm feed mixing reflects almost 50% of the total feed production in the four countries (excluding roughages). However, this is 48% dairy feed, where soy replacement is easily possible (except for high-performing dairy cows and in milk replacer) and 41% pig feed, where only in piglet and starter feed the soy is nutritionally necessary. We left out the other feed, e.g. for sheep and goats and petfood, from our analysis. We consider the necessary substitution of 20-30% soy in feed to not be overestimated.

The organic animal production will likewise face increasing feed prices, as organic soy is non-GM. With the assumed increased premium for non-GM soy, the organic soy is likely to be absorbed in the non-

GM soy supply. Rising feed costs for organic animal production will not only be found in the opt-out countries, but in other countries in Europe and worldwide as well.

An equal competition might theoretically occur with non-GM soy for human consumption. However, non-GM soy for food use is currently paying substantial premiums over what feed is paying. Feed use is assumed to never be able to access the volumes that are currently going to food use, due to higher premium because of specific varieties (*white hillum*), stringent separation on the collection of the non-GM soybeans (containers at the harvested field) and much higher logistic costs (container instead of bulk commodity shipment).

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Appendix 1 Interviewees

Mr. Jaap Biersteker	Consultant and expert in the edible seeds and oil processing, UK
Dr. Bert Lotz	Crop scientist at Plant Sciences Group, Wageningen University and Research Centre, Wageningen, Netherlands
Mr. Jannes Doppenberg	Schothorst Feed Research, Lelystad, Netherlands
Mr. Augusto Freire	President ProTerra Foundation, Brazil
Mr. Frans Köster	MVO, Zoetermeer, Netherlands
Ms. Paulien van de Graaff	Het Comité van Graanhadelaren, Rotterdam, Netherlands
Two anonymous interviewees	Representatives from international feed companies, who preferred not to be mentioned by name and company.
Mr. Zoltan Pulay	Director of UBM feed Kft., Hungary

Appendix 2 Trade data

Table A2.1

Soybean trade by the four opt-out countries in 2014 (1,000 tonnes) and annual growth (% per year, years 2009-2014)

	Export		Import		Net import	
	Volume	Growth	Volume	Growth	Volume	Growth
France	28	8.2	701	1.9	673	1.7
Germany	59	10.7	3,709	3.2	3,650	3.1
Hungary	36	8.0	119	52.6	83	-251.4
Poland	1	94.9	34	37.0	33	36.5
Total 4 opt-out countries	124	9.4	4,563	3.6	4,439	3.5
Rest of EU	1,669	5.6	11,029	3.2	9,360	2.8
Total EU	1,793	5.8	15,592	3.3	13,799	3.0
World	119,556	8.0	111,179	8.1	a)	a)
Opt-out in % total EU	6.9		29.3		32.2	a)
Opt-out in % total World	0.1		4.1			

a) no data available.

Source: Based on UN Comtrade.

Table A2.2

Soybean meal trade by the four opt-out countries in 2014 (1,000 tonnes) and annual growth (% per year, years 2009-2014)

	Export		Import		Net import	
	Volume	Growth	Volume	Growth	Volume	Growth
France	227	20.5	3,177	-3.0	2,950	-4.0
Germany	1,426	1.5	2,698	-4.1	1,271	-8.6
Hungary	64	6.7	413	-7.1	349	-8.7
Poland	79	8.0	1,954	2.1	1,876	1.9
Total 4 opt-out countries	1,796	3.5	8,242	-2.6	6,446	-3.9
Rest of EU	5,674	0.2	16,314	-0.3	10,640	-0.6
Total EU	7,470	1.0	24,556	-1.1	17,086	-1.9
World	62,910	2.5	60,922	2.0	a)	a)
Opt-out in % total EU	24		34		38	a)
Opt-out in % total World	3		14			

a) no data available.

Source: Based on UN Comtrade.

Table A2.3

Rapeseeds trade by the four opt-out countries in 2014 (1,000 tonnes) and annual growth (% per year, years 2009-2014)

	Export		Import		Net import	
	Volume	Growth	Volume	Growth	Volume	Growth
France	931	-5.5	931	4.2	0	-77.4
Germany	174	-5.7	4,161	5.1	3,987	5.7
Hungary	554	6.4	68	51.2	-486	4.1
Poland	350	10.9	163	-12.9	-187	-209.8
Total 4 opt-out countries	2,008	-0.8	5,323	4.2	3,314	8.0
Rest of EU	3,615	11.4	5,381	10.2	1,766	7.8
Total EU	5,624	6.1	10,704	6.9	5,080	7.9
World	20,393	5.8	22,150	7.1	a)	a)
Opt-out in % total EU	35.7		49.7		65.2	a)
Opt-out in % total World	9.8		24.0			

a) no data available.

Source: Based on UN Comtrade.

Table A2.4

Rapeseed meal trade by the four opt-out countries in 2014 (1,000 tonnes) and annual growth (% per year, years 2009-2014)

	Export		Import		Net import	
	Volume	Growth	Volume	Growth	Volume	Growth
France	397	11.5	449	3.0	52	-19.8
Germany	1,800	2.4	361	4.8	-1,439	1.8
Hungary	50	9.1	40	25.7	-10	-12.5
Poland	365	4.9	43	59.6	-322	2.6
Total 4 opt-out countries	2,612	4.0	893	5.3	-1,718	3.3
Rest of EU	1,413	-1.8	1,874	-4.0	461	-9.2
Total EU	4,025	1.7	2,768	-1.5	-1,257	12.0
World	8,292	6.5	6,681	5.5	a)	a)
Opt-out in % total EU	64.9		32.3		136.7	a)
Opt-out in % total World	31.5		13.4			

a) no data available.

Source: Based on UN Comtrade.

Table A2.5

Sunflower seeds trade by the four opt-out countries in 2014 (1,000 tonnes) and annual growth (% per year, years 2009-2014)

	Export		Import		Net import	
	Volume	Growth	Volume	Growth	Volume	Growth
France	443	5.5	361	1.8	-82	55.9
Germany	33	5.8	469	1.2	436	0.9
Hungary	464	-8.4	264	57.9	-201	-21.9
Poland	4	-5.2	43	6.3	39	7.9
Total 4 opt-out countries	945	-2.8	1,137	6.5	192	-194.2
Rest of EU	2,742	6.5	2,099	5.2	-643	11.6
Total EU	3,687	3.6	3,236	5.6	-451	-6.5
World	4,811	0.3	4,550	2.2		
Opt-out in % total EU	26		35		43	
Opt-out in % total World	20		25			

Source: Based on UN Comtrade.

Table A2.6

Sunflower meal trade by the four opt-out countries in 2014 (1,000 tonnes) and annual growth (% per year, years 2009-2014)

	Export		Import		Net import	
	Volume	Growth	Volume	Growth	Volume	Growth
France	153	-1.8	961	14.0	808	19.5
Germany	116	1.8	347	14.4	232	26.4
Hungary	372	24.3	28	-10.8	-344	35.5
Poland	29	42.9	486	1.3	457	0.3
Total 4 opt-out countries	669	10.7	1,822	9.0	1,153	8.2
Rest of EU	1,211	11.1	3,122	4.9	1,911	1.8
Total EU	1,880	10.9	4,944	6.3	3,065	3.9
World	7,873	5.9	7,408	6.6		
Opt-out in % total EU	36		37		38	
Opt-out in % total World	8		25			

Source: Based on UN Comtrade.

Appendix 3 Protein balance and developments in Ukraine and India

Ukraine

The oilseed production in Ukraine is growing fast. Table A3.1 shows that the annual growth percentages in the period 2003-2013 (meals 2001-2011) are in double digits. The demand growth for pork feed is low and negative for dairy. The demand for poultry feed grew fast in the period 2002-2011. The production of seeds grew significantly faster than the poultry feed demand. The production growth of sunflower meal, the largest quantities of the 3 presented meals, is just below the growing demand of poultry feed. The conclusion is that if these developments will continue, Ukraine will have an additional supply of meal for export and even more seeds as these grew faster than the production of oil meals (hence processing of oilseeds). As an example, if the growth trend will continue, Ukraine is projected to supply an additional 1m tonnes of soybeans, 1m tonnes of rapeseed, 2m tonnes of sunflower seed in 2020. Currently, 40% of the soybean production in Ukraine is GM soy. Additional effort has to be made to ensure that expansion is non-GM soy.

Table A3.1

Production of oil seeds and meals and animal products in 2013 and projected for 2020 in Ukraine (million tonnes), annual growth (2003-2013, % per year) a) b)

	Production 2013	Annual growth	Production 2020
Rapeseed meal	0.05	4.8	0.09
Soybean meal	0.26	19.2	0.52
Sunflower meal	3.06	13.0	4.75
Poultry meat	1.02	12.6	1.48
Pork meat	0.73	1.4	0.69
Dairy (milk)	11.19	-1.8	9.29
Rapeseed	2.35	46.7	3.34
Soybeans	2.77	28.2	3.80
Sunflower seed	11.05	10.0	13.11

a) Projection for 2020 is based on linear trend extrapolation; b) For meals, the current production is based on 2011 (rather than 2013) and the annual growth is based on the years 2001-2011.

Source: Calculations based on FAOstat

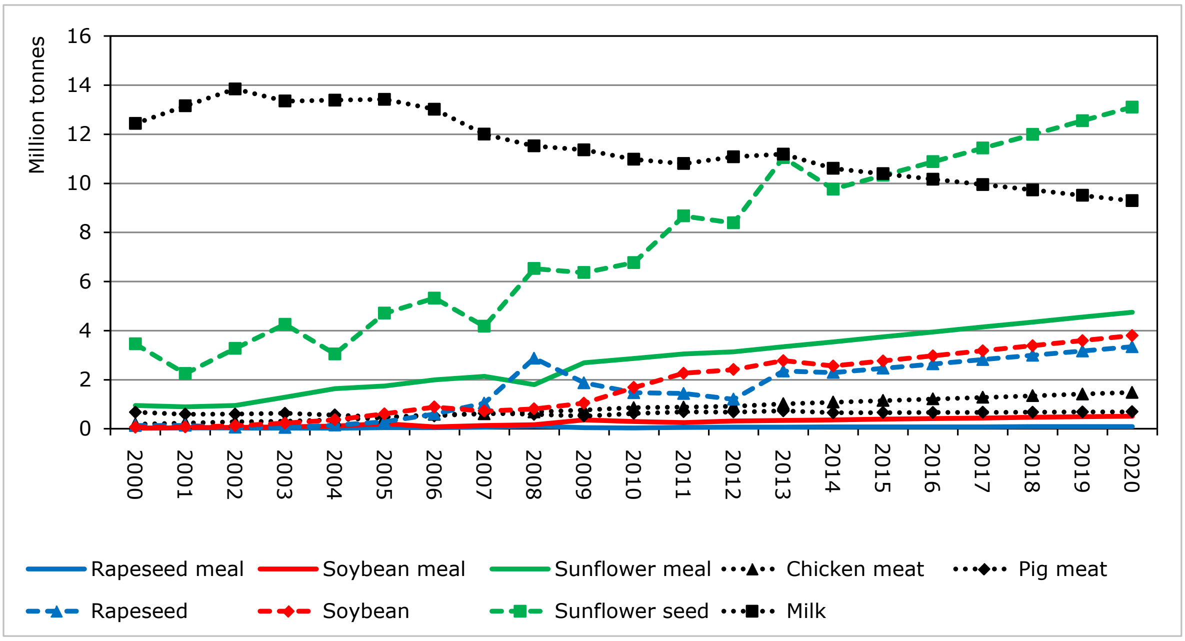

Figure A3.1 *Development and projection of production of oil seeds, meals, meat and milk in Ukraine (m tonnes)*
Source: Calculations based on FAOstat.

India
The oilseed production in the India is growing. Table A3.2 shows that the annual increase in the period 2003-2013 amounts to 7-8% for rapeseed and meal and between 3 and 4% for soybeans. The higher growth for rapeseed meal indicates stronger increasing processing capacity than production of seeds. For soybeans the opposite can be observed: the production grew faster than the processing capacity. The demand for pig meat is decreasing, but increasing for dairy and chicken meat. The production of rapeseeds grew faster than the poultry and dairy feed demand.

Based on the trend, India is expected to some additional supply of soybean meal. Due to the increase trend of rapeseed production and processing above the growth of dairy and chicken meat, it is expected that the export levels of soybean meal will remain at least on the same level. The trend shows a slightly growing gap between the milk and the soybean meal production.

Table A3.2
Production of oil seeds and meals and animal products in 2013 and projected for 2020 in India (million tonnes), annual growth (2003-2013, % per year) a)

	Production 2013	Annual growth	Production 2020
Rapeseed meal	4.05	7.8	4.91
Soybean meal	7.52	3.1	12.52
Sunflower meal	0.26	-4.2	0.31
Poultry meat	2.33	6.7	3.33
Pork meat	0.35	-2.8	0.27
Dairy (milk)	60.60	5.7	78.06
Rapeseed	7.82	7.3	9.40
Soybeans	11.95	4.3	18.41
Sunflower seed	0.60	-4.3	0.63

a) Projection for 2020 is based on linear trend extrapolation.

Source: Calculations based on FAOstat

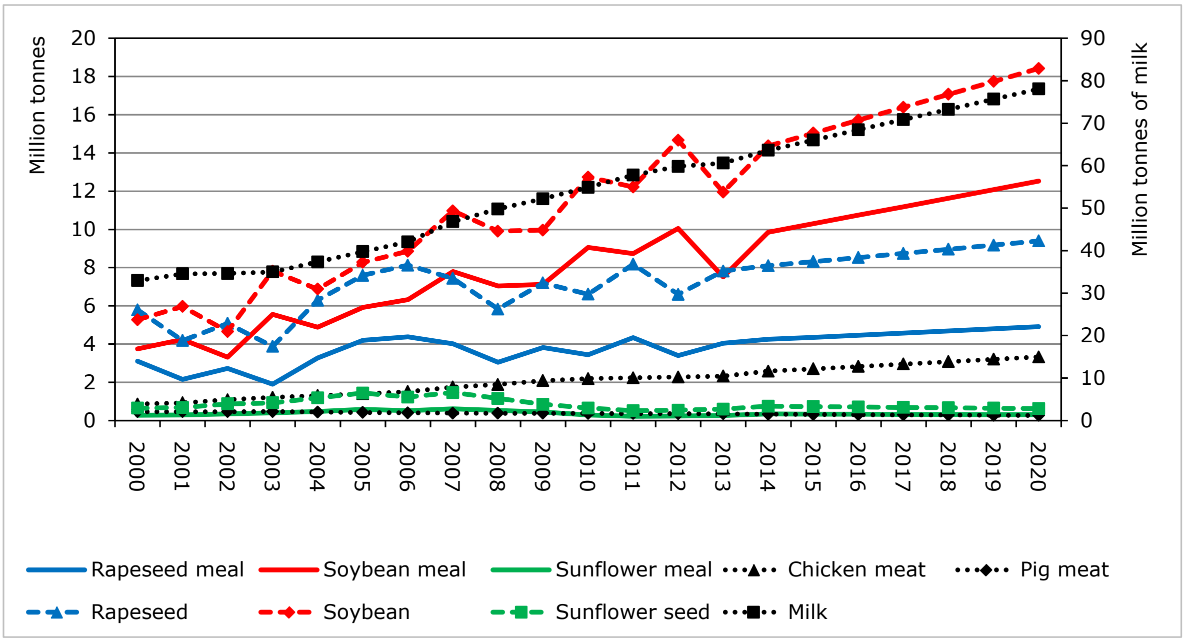

Figure A3.2 *Development and projection of production of oil seeds, meals, meat and milk in India (m tonnes)*
Source: Calculations based on FAOstat.

LEI Wageningen UR
P.O. Box 29703
2502 LS The Hague
The Netherlands
T +31 (0)70 335 83 30
E publicatie.lei@wur.nl
www.wageningenUR.nl/en/lei

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LEI Wageningen UR
P.O. Box 29703
2502 LS Den Haag
The Netherlands
E publicatie.lei@wur.nl
www.wageningenUR.nl/lei

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